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MAY 29, 1937


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AUTOMOTIVE INDUSTRIES

May 29, 1937
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Active Summer Planned

June and early summer production will almost certainly be higher than was originally scheduled because of the many interruptions this past spring. The effort will be to make up some lost ground before model changes. Some producers have already raised their projections for the coming month. Latest reason for the loss of a full day by the industry is the Memorial Day holiday. Because of union agreements calling for time and one-half for holiday work, it is likely that all plants will close. Costs have already risen to the point where the saving is important.

Car Sales Near Year's High

Shortages Still Hamper Some Dealers; Summer Production to be Raised; Used Car Stocks Declining Steadily

Motor vehicle sales are holding up around the best levels of the year. The seasonal peak is being prolonged by a big backlog of orders. Where field stocks are adequate, retail deliveries have climbed above the April level but many dealers are prevented from obtaining maximum possibilities of the present market by car shortages.

The peak has not been reached in used car sales. Each reporting period shows a further rise in volume and used car stocks are not causing any concern this season. Because of the shortage of new cars, dealers have been able to give more attention to other departments of their business. That is one of the reasons why their used cars are moving faster and why they are also doing a bigger accessory business.

The numerous "wild-cat" strikes that have cropped up all through the industry during May have hampered production and kept many plants from attaining their scheduled output for the month. They were particularly serious last week when Studebaker, Plymouth and Chevrolet were the principal sufferers. This week Ford has one assembly plant closed by a strike. In all, the various stoppages have so curtailed the production of the industry that it is now a question whether May will be able to show any gain over April's total of 553,415 cars and trucks.

On the basis of original schedules, May was due to set a new high for production this year with a good margin over the April figure. But it appears now that the two months will be just about even. Although April lost considerable in the way of output because of the strikes which kept the Chrysler and Hudson plants closed until nearly the middle of the month, it had the advantage of two more working days and with the industry turning out close to 28,000 units daily, the loss of two days' production makes a considerable dent in the month's total.

The effect of the many interruptions to production will be higher summer schedules.

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Probe Ford-UAW Skirmishes

Three Investigations Into Detroit Fight Begun; Mass Meeting Called with Sen. LaFollette Invited to Speak

A mass meeting of United Automobile Workers members has been called for early next week to protest "Ford brutalities" in connection with the ejection of union organizers from Ford Motor Co. property, May 26. The fist-fighting fracas occurred when a group of union members invaded Ford property for the purpose of distributing hand bills to workers. Richard T. Frankensteen, organization director of the UAW, and Walter Reuther, president of the West Side local, were badly beaten.

The union promptly filed formal complaint with the NLRB charging intimidation, coercion and interference with the workers' constitutional rights. Three investigations have been started. In addition to the labor board, the LaFollette Civil Liberties Committee of the Senate, and the Wayne County prosecutor's office have launched investigations.

Harry Bennett, Ford personnel director, called the fight a frame-up by the union to bring the LaFollette committee into the picture and make political capital for the union. He denied that any member of the Ford service department took part. "Any fighting that was done was done by individual Ford workmen who took it upon themselves to do so, and not by service men." Frankensteen, who was in the thick of the fighting declared, "one of the men who helped to beat me was a Ford service man. I recognized him because I had met him in negotiating a labor dispute at another plant." According to Frankensteen and Reuther, they did not realize they were on Ford property but thought that they were on public property because they were above a public thoroughfore on an overpass.

The protest meeting will be held under joint offices of the UAW and the

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This Week

NEWS from the field reports the developments in the labor situation including the initial moves in the Ford organization drive . . . Ford Motor Co. annual statement is published . . . New Autocar and Marmon-Herrington models are described . . . Car sales reported near the best levels of the year . . . Sloan hints at another New Jersey plant.

FEATURES include advance engineering details of the race cars at Indianapolis by Chester S. Ricker and an article on racing car design by D. Railton of England . . . Details of the new Oldsmobile automatic transmission are presented . . . Abstracts of AFA meeting papers given.

EXCLUSIVE contract for collective bargaining is signed by Russell Merrill, president of the UAW Local No. 5, at the Studebaker plant on May 21. From left to right are Walter S. Gundeck, Studebaker director of industrial relations; Ralph A. Vail, vice-president in charge of manufacturing; Bert F. Fowler, general plant superintendent; George W. Walsh, UAW vice-president; Paul G. Hoffman, Studebaker president, and fourth from the right is Harold S. Vance, chairman of the board of the automobile company.

Nash to Raise Output

Will Increase Capacity 30%; Seen Adding Commercial Line

Nash Motors division of Nash-Kelvinator Corp. has announced institution of a plant improvement program costing $1,500,000 in time for 1938 model production. Capacity will be increased 30 per cent. The main plant at Kenosha, Wis., is to be completely air-conditioned and the foundry and machine shops materially enlarged. The branch factory at Racine, Wis., will receive a second assembly line, stepping up output from 40 cars an hour to 100. At the Seaman Body Corp. in Milwaukee, two new body panel presses will be installed, with a new conveyor system alone costing $150,000 to eliminate trucking of materials on factory floors.

Present plans do not contemplate reopening of the Milwaukee Nash plant, idle since 1930, and in recent months used for storage of new cars for water shipment from Milwaukee by Great Lakes and Welland Canal routes to the eastern seaboard.

Nash officials are considering re-entry of the commercial car field in which it was once a leader, especially in the production of Nash Quads for the Government during the World War. It is believed likely, however, that it will shortly offer commercial cars on both Nash and LaFayette passenger car chassis. House trailers have been definitely rejected as a possible product, according to Robert B. Elliott, Kenosha, vice-president in charge of all production.

Names Highway Study Group

Appointment of 12 highway engineering experts to work with the Bureau of Public Roads in raising highway design standards in the interest of safety and utility has been announced by Secretary of Agriculture Wallace.

All of the men are State highway officials and members of the American Association of State Highway Officials. Thomas H. MacDonald, chief of the bureau, will act as chairman of the committee. The committee will be composed of C. H. Purcell of California, Ernst Lieberman of Illinois, Fred Kellam of Indiana, Hugh Barnes of Kansas, G. H. Delano of Massachusetts, O. L. Kipp of Minnesota, Murray D. Van Wagoner of Michigan, Harold W. Griffin of New Jersey, R. H. Baldock of Oregon, P. M. Tebbs of Pennsylvania, Gibb Gilchrist of Texas and C. S. Mullen of Virginia.

Connecticut Requires Safety Glass

A new Connecticut law requires safety glass on all automobiles manufactured after July 1, 1937. Another new law there holds loaded truck heights to 12 ft. 6 in., excepting for loads of hay and straw, but provides for applications for special condition permits. A bill adopted by both houses requires defrosters on vehicles used to transport school children and public service vehicles.

Studebaker Resumes

UAW Gets Exclusive Pact With Cancellation Clause

Work at full capacity was resumed at the Studebaker corporation plant, May 24, with nearly 7000 members of the United Automobile Workers Local No. 5 returning to their jobs under contract and claiming a 100 per cent unionized shop. The temporary shutdown was caused by a walkout in the final assembly line last Wednesday, when union workers refused to work with non-union and those who had failed to pay their dues.

The return to work is the result of an overwhelming approval of the new wage and hour contract voted by members of the UAW last Friday. The contract has been under consideration for the last five weeks by both the Studebaker corporation officials and officials of the union, and will increase the payroll by approximately $700,000 annually.

The agreement calls for a flat increase of three cents an hour for factory workers, but this amounts to six and one-half cents an hour due to other adjustments in piece rates. It raises the average pay of Studebaker factory employes from 94 to 96½ cents an hour.

Paul G. Hoffman, president of the Studebaker corporation, and Harold S. Vance, chairman of the board, issued a joint statement expressing their pleasure over the ratification of the working contract by the union. It said: "Formal approval of the union of this agreement serves to consolidate in permanent form an orderly procedure for handling problems between management and men which traditionally has been inherent in Studebaker practice. We are confident that its operation will cement further the friendly relationships existing between Studebaker management and employes and insure maintenance of the unusually high quality which has always characterized Studebaker products."

The agreement in part is as follows: "The Studebaker company accepts the representations of the United Automobile Workers of America Local Union

April Truck Output Sets New Record

Passenger Car and Truck Production—(U.S. and Canada)

	April, 1937	March, 1937	April, 1936	Four Months, 1937	Four Months, 1936
Passenger Cars—U. S. and Canada:					
Domestic Market—U. S.	410,592	376,245	395,182	1,349,046	1,204,069
Foreign Market—U. S.	29,388	27,634	21,249	101,086	77,135
Canada	12,927	19,313	20,247	61,664	56,849
Total	452,907	423,192	436,678	1,511,796	1,338,053
Trucks—U. S. and Canada:					
Domestic Market—U. S.	79,788	75,979	74,363	263,666	245,696
Foreign Market—U. S.	16,566	14,418	11,880	60,854	48,180
Canada	4,154	5,388	4,704	19,408	12,693
Total	100,508*	95,785	90,947	343,928	306,569
Total—Domestic Market—U. S.	490,380	452,224	469,545	1,612,712	1,449,765
Total—Foreign Market—U. S.	45,954	42,052	33,129	161,940	125,315
Total—Canada	17,081	24,701	24,951	81,072	69,542
Total—Cars and Trucks—U. S. and Canada	553,415	518,977	527,625	1,855,724	1,644,622

*Highest for any month in history.

No. 5 that its membership constitutes more than a majority of the hourly rated employes in its South Bend plants, and consequently, in accordance with Section 9 (a) of the National Labor Relations Act, the company recognizes the union as the exclusive representatives of its hourly rated employes in its South Bend plants, for the purpose of collective bargaining in respect to rates of pay or wages, hours of employment, or other conditions of employment.

"The company will not interfere with the right of its employes to become members of the union. Neither the company nor any of its agents will exercise discrimination, interference, restraint or coercion against any member of the union because of such membership.

"The union or its members will not intimidate or coerce employes in any manner, nor solicit or sign up members on company time."

Employes of the engineering division are to be retained or released according to their individual abilities and skills as determined by the management notwithstanding provisions of the contract affecting other departments.

"Should any grievance arise in respect to rates of pay or wages, hours of employment, or other conditions of employment, there shall be no slow down or stoppage of work but every effort shall be made to settle the grievance in the following manner:

"First: Between the department stewards and department foremen.

"Second: Between the divisional committeeman and division superintendent and/or industrial relations director.

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UAW Dues Held Cause of Tension

Union Needs Closed Shop to Assure Continued Strength; Threats Are Major Part of Underlying Strategy

Detroit Special Correspondence

Disregarding the implications of the United Automobile Workers' effort to unionize Ford workers, the underlying cause for continued labor tension in the automobile industry is not hard to define, although frequently misunderstood. The United Automobile Workerse is out to make closed shops in the automobile industry. Bulking large in its insistence on this objective is the fact that maintenance of membership and collection of dues is extremely difficult, if not impossible, when the individual workman is left absolutely free to choose his own course.

Throughout the industry numerous instances are being cited of high spoilage of work accruing to men who refuse to join the union, particularly those whose opposition takes the form of vocal refusal. Strongly opposed to the union in principle, more than one production supervisor has been caught wishing that, for the moment at least, union opposers would keep quiet and not goad their dues-paying fellow workers to anger at seeing someone getting the same pay, hours and working conditions as themselves without paying union officials for the privilege. There are even rumors of manufacturing men taking a production-at-any-cost attitude on occasion and advising harassed union-resisters to go ahead and join. There are hundreds of authentic cases of employees actually begging company officials for protection against coercion by union members.

The closed shop has not been achieved anywhere in the automotive industry, however, in spite of the constant pressure exerted by the UAW to keep managements in fear of production interruptions. This same pressure is necessary also to keep workers interested in paying their dues or afraid not to pay them.

Current uncertainty about work-stoppage has almost nothing whatever to do with wages, hours, working con-

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ACME

FORDISMS, Henry Ford's comments on the value of union membership which were distributed to workers last week in pamphlet form, are cheerfully burned up by CIO-affiliated men at the Kansas City plant. The union is expected soon to answer with a handbill of its own as one step in the drive to organize a majority of Ford's men.

ASTM to Meet in New York

The fortieth annual meeting of the American Society for Testing Materials, to be held at the Waldorf-Astoria, New York, June 28-July 2, will be featured by an address by the president, A. C. Fieldner, Chief, Technologic Branch, U. S. Bureau of Mines, on the subject of "Fuels of Today and Tomorrow," and also by the twelfth Edgar Marburg lecture, which will bear the title "Plastics; Some Applications of the Different Classes, Methods of Testing," and will be delivered by Dr. T. Smith Taylor, Professor of Physics at Washington and Jefferson College. Concurrently with the meeting there will be held the fourth A.S.T.M. exhibit of testing apparatus and related equipment.

In his presidential address, to be presented on Monday, June 28, at 3.30 p. m., Dr. Fieldner will cover solid, liquid and gaseous fuels. As regards petroleum, he plans to cover the estimated proven reserves, undiscovered reserves, oil shales, and natural gasoline. The lecture will deal especially with automotive fuels, discussing supplementary sources of gasoline, such as oil shale, hydrogenation of coal, synthesis of motor fuel from water gas and steam, mining of oil sands, and fuels from renewable sources such as the alcohol from fermentation of vegetable material. He plans also to outline the potential national fuel situation 25 years hence.

The Edgar Marburg lecture on plastics will be delivered on Wednesday, June 30, at 4.15 p. m.

Chrysler Buys Kokomo Plant

While no announcement has been made by the company, it has been confirmed that Chrysler Corp. has acquired the old Haynes automobile plant at Kokomo, which has been out of production for several years. The work of remodeling and equipping the plant is expected to start next month and, with the purchase price, is understood to involve an expenditure of $2,500,000. The plant is to be used by the Dodge divisions for parts manufacture.

Indianapolis Awaits Records

Commercial Gasoline Used; Track Resurfaced for Safety; AAA Contest Schedules for Season Published

Thirty-three racing cars are scheduled to start in the Silver Anniversary Indianapolis 500 mile race Monday morning. Indications point to a new speed record with the commercial gasoline required by the new rules this year. Average speed for the 1936 race was 109.069 m.p.h., also a record.

This will be the 25th race over a span of 27 years. There were no races in 1917 or 1918, World War years. The track has been resurfaced for the race to reduce accident hazards on the curves.

Entered are front and rear wheel drive cars. Most of them are of American make, but there are two Italian productions, one an Alfa Romeo and the other a Maserati, the former entered by Bill White of Los Angeles, and the latter by Bob Topping of New York.

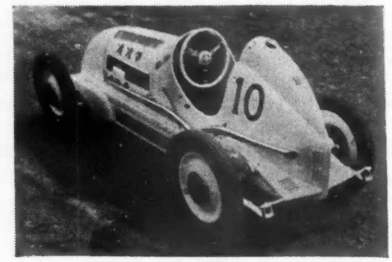
This is the first race in which doped fuel will be barred. Drivers must qualify and race on the same fuel. There is no limitation as to amount of gasoline this year. In 1935 only 37½ gals. were allowed for the race. A special prize will be offered for gasoline economy.

Official pacemaker is the LaSalle which Ralph DePalma recently drove for 500 miles on the track at an average of 82.19 m.p.h., a new stock car record. T. E. Allen, secretary of the A.A.A. Contest Board, is using a DeSoto as his official car.

The American Automobile Association announces its list of sanctioned races for this season, which will officially end on Oct. 17 as follows:

Date	Place	Type	Promotor
May 30	Trenton (N. J.), Fairgrounds	Sprints	Ralph Hankinson
May 31	Indianapolis Motor Speedway	500-Mile Intl. Sweepstakes	Indianapolis Motor Speedway Corp.
May 31	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone
May 31	Altamont (N. Y.), Fairgrounds	Sprints	Albany-Schenectady Fair
May 31	Readville (Mass.), Speedway	Sprints	Douglas Yule
June 6	Cook County (Chicago) Fairgrounds	Sprints	Carl Stockholm
June 6	Union (N. J.), Speedway	Sprints	Andy Watts
June 12	Mineola, N. Y.	Sprints	Ralph Hankinson
June 13	Cleveland, Ohio	Sprints	B. Ward Beam
June 13	Langhorne (Pa.), Speedway	Sprints	Ralph Hankinson
June 20	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone
July 3	Roosevelt Raceway, Roosevelt Field, Westbury, L. I., N. Y.	Vanderbilt Cup Race	Motor Development Corp.
July 4	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone
July 5	Readville (Mass.), Speedway	Sprints	Douglas Yule
July 18	Cook County (Chicago), Fairgrounds	Sprints	Carl Stockholm
July 25	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone
July 31	Harrington, Del.	Sprints	Ralph Hankinson
Aug. 1	Pan American Exposition Grounds, Dallas, Texas	Pan American 300-Mile Race	Pan American Exposition
Aug. 7	Lewistown (Pa.), Fairgrounds	Sprints	Ralph Hankinson
*Aug. 13	Altamont (N. Y.), Fairgrounds	Sprints	Ralph Hankinson
*Aug. 14	Altamont (N. Y.), Fairgrounds	Sprints	Ralph Hankinson
Aug. 15	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone
**Aug. 21	Middletown (N. Y.), Fairgrounds	Sprints	Ralph Hankinson
*Aug. 21	Springfield (Ill.), Fairgrounds	Sprints	Ralph Hankinson
Aug. 22	Cook County (Chicago), Fairgrounds	Sprints	Carl Stockholm
*Sept. 4	Flemington (N. J.), Fairgrounds	Sprints	Ralph Hankinson
*Sept. 6	Flemington (N. J.), Fairgrounds	Sprints	Ralph Hankinson
Sept. 6	Roosevelt Raceway, Roosevelt Field, Westbury, L. I., N. Y.	Pan American Sweepstakes	Motor Development Corp.
Sept. 6	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone
Sept. 6	Readville (Mass.), Speedway	Sprints	Douglas Yule
*Sept. 11	Ruthland (Vt.), Fairgrounds	Sprints	Ralph Hankinson
Sept. 11	New York State Fair, Syracuse**	100-Mile Natl. Championship	Ira Vail
*Sept. 18	Reading (Pa.), Fairgrounds	Sprints	Ralph Hankinson
Sept. 19	Cook County (Chicago), Fairgrounds	Sprints	Carl Stockholm
Sept. 25	Nashville, Tenn.	Sprints	Ralph Hankinson
*Sept. 25	Allentown (Pa.), Fairgrounds	Sprints	Ralph Hankinson
Sept. 26	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone
*Oct. 2	Richmond (Va.), Fairgrounds	Sprints	Ralph Hankinson
*Oct. 2	Trenton (N. J.), Fairgrounds	Sprints	Ralph Hankinson
*Oct. 9	Wilson (N. C.), Fairgrounds	Sprints	Ralph Hankinson
*Oct. 9	Shelby (N. C.), Fairgrounds	Sprints	Ralph Hankinson
Oct. 12	Readville (Mass.), Speedway	Sprints	Douglas Yule
*Oct. 16	Spartanburg (S. C.), Fairgrounds	Sprints	Ralph Hankinson
*Oct. 16	Raleigh (N. C.), Fairgrounds	Sprints	Ralph Hankinson
Oct. 17	Hohokus (N. J.), Speedway	Sprints	Jimmy Johnstone

* County Fair. ** State Fair.



JAPANESE example of streamlined racing car. It is the OHTA and has defeated several foreign competitors.

Visibility Bill Coming

Sen. Lonergan to Seek Law Setting Vehicle Rules

Senator Lonergan of Connecticut, who has been working on safety legislation for two years, has announced that he will introduce a bill to increase motor vehicle visibility. Such legislation, if enacted, would mean a marked change in automobile engineering because of its effect in redrafting present-day streamlined designs. It was stated that automotive engineers and manufacturers, as well as other interested sources, will be heard before the bill is offered for passage.

Senator Lonergan likewise has announced that he will ask for immediate passage of a bill to have the Bureau of the Census make a special study of automobile accidents and their causes. An appropriation will be asked to conduct the study. Should the study be made, the bill on visibility may be held up until a report is made by the Director of the Census.

In many instances, Senator Lonergan said, traffic mishaps may be traced directly to obscured vision on the part of drivers. He said that certain types of streamline cars' visibility is as low as 4 per cent. The proposed bill would set a minimum visibility standard and set a time for compliance with such a standard, possibly January 1, 1939, or a year later. Each community, the Senator said, could establish visibility requirements, depending upon highway conditions, such as widths, lighting, etc.

R. G. MARSHALL has been appointed export manager of Covered Wagon Co., trailer coach manufacturers, it was announced by J. E. Roberts, vice-president in charge of sales. Marshall succeeds V. H. Wilcox, who has resigned to undertake other activities.

DR. EARL G. STURDEVANT has been named consulting engineer of the electrical wire and cable department of the U. S. Rubber Products, Inc. Dr. Sturdevant joined United States Rubber Products, Inc., in 1929, coming directly from Western Electric. He contributed in the work of commercially applying the process of the

Hopkinson and Gibbons patent for forming a rubber thread directly from latex.

BYRON C. FOY, president of the DeSoto Motor Corp., has again been named chairman of the show committee in charge of the National Automobile Show, to open Oct. 27 in Grand Central Palace, New York.

R. H. GRANT, vice-president of General Motors Corp., has succeeded the late A. H. Swayne on the committee. Third member is Paul G. Hoffman, president of the Studebaker Corp.

FERD M. BROWN, has been appointed director of Graham-Paige sales in the Southern part of the United States, it was announced by F. R. Valpey, vice-president and general sales manager.

Harold C. Hatch has been named sales engineer of Gar Wood Industries, Inc., Mead-Morrison Division.

Car Sales Near High

(Continued from page 787)

Domestic retail deliveries of Buick cars during the second ten days of May were 7702 cars, compared with 7214 in the corresponding period of April and 5549 in the second ten days of May, 1936. A record total of 11,554 used cars were retailed by Buick dealers during the second ten days of the month.

The LaSalle V 8 which invaded the lower medium price bracket last fall has climbed to fifth place in a field of 13 automobile makes, Sales Manager D. E. Ahrens announced. Meanwhile, Mr. Ahrens declared, higher priced Cadillac lines have also scored heavily in their respective fields. "We are now getting one of each four car sales in the $1250-$2000 class," he said.

Production of Lincoln-Zephyr motor cars at the Lincoln factory has passed 22,000 units for the 1937 season, it was announced at the Lincoln Motor Company offices. This total is almost 50 per cent greater than the entire production of Lincoln-Zephyr cars during the 1936 season, the statement said.

Graham retail deliveries for April were 1651 cars or 20 per cent ahead of those for March, said F. R. Valpey, vice-president and general sales manager of the Graham-Paige Motors Corporation.

Truck and commercial car sales by The Studebaker Corporation during April established a new all-time high mark for the third consecutive month, according to Geo. D. Keller, vice-president in charge of sales. A total of 1557 units were sold during April topping by 150 units the previous record of 1407 for March.

Ford Motor Net Rises for 1936

Increase in Profit and Loss Surplus Equals $5.70 a Share; Reserves $6,737,677 Higher, Balance Sheet Shows

Profit and loss surplus of the Ford Motor Co. increased $19,689,021 in 1936, it was shown by a comparison of balance sheets for that year and for 1935. The 1936 statement was filed with the Commissioner of Corporations and Taxation of the Commonwealth of Massachusetts. This figure, apparently net after charges, reserves and dividends, is the only indication of the company's profits for the year, and was equal to $5.70 a share on the 3,452,900 shares of $5 par stock. It compared with an increase in profit and loss surplus for 1935 of $2,701,260 or 78 cents a share.

In addition to the increase in profit and loss surplus, the company's reserve account increased $6,737,677 during the year, compared with an increase for 1935 of $864,357.

The surplus from 1936 operations was the largest indicated since the year 1930 when it was $44,460,823.

The Ford Motor Co.'s official world production figures for 1936 were 1,194,000 cars and trucks, against 1,342,346 for 1935, and against 1,500,000 for 1930.

A note to the balance sheet stated that the item of "cash" in the balance sheet, carried at $378,119,715, included accounts and notes receivable, security holdings, patent rights, trademarks, and the like. Securities were stated to have been carried at cost; there were no contingent liabilities and no assets were pledged.

Following is a comparison of 1936 and 1935 balance sheets:

Assets	Dec. 31, '36	Dec. 31, '35
Real estate	$123,275,143	$141,004,515
Machinery & equipment	118,519,374	91,536,808
Inventory	95,002,834	68,568,702
*Cash	378,119,715	377,310,316
Deferred charges	2,442,300	3,129,587
Total	$717,359,366	$681,549,929
Liabilities		
Capital stock	$17,264,500	$17,264,500
Accounts payable	79,729,171	70,346,432
Reserves	17,699,023	10,961,346
Profit and loss	602,666,672	582,977,651
Total	$717,359,366	$681,549,929

Trailer Sales Data

Census Bureau Makes First Factory Volume Check

A total of 53,646 automobile trailers valued at $27,421,763 was sold by 357 manufacturers in 1936, according to the first special survey of the market by the Bureau of the Census.

These factory sales were broken down into 16,173 house or coach trailers valued at $8,496,021; 10 house cars valued at $9,521; 11,069 passenger car trailers of all other types valued at $771,627; 2519 motor truck trailers valued at $2,296,444; and 23,875 motor truck semi-trailers valued at $15,848,150.

The value of factory sales of automobile trailers for 1936 compared with a total value of automobile trailers produced in 1935 of $18,850,734, as reported to the Census of Manufactures for that year. Production value in 1935 for house or coach trailers was $1,840,497. Production value in 1935 of motor truck trailers and semi-trailers was $17,010,237. The factory sales value of these two classes in 1936 was $18,144,594.

The bureau said that the aggregate number of manufacturers exceeds 357 because some manufacturers sell more than one type of trailer. Within the figure of 357, the largest number in any state was 86 in California and 58 in Michigan. Largest number of trailers of all types sold was 22,728 in Michigan, 7750 in Ohio by 22 manufacturers, and 4618 in California. The two largest sales volumes for house or coach trailers were 11,036 in Michigan and 2228 in California. Michigan and Ohio together reported the sale of 12,487 motor truck trailers and semi-trailers. Second largest state volume was in California where its was 1579.

PACEMAKER for the 25th 500 mile race at Indianapolis on May 31 is this LaSalle V8 which has just set a new stock car record for 500 miles of 82.19 m.p.h. Ralph DePalma, who drove it, is on the right, talking with Stanley L. Reed, AAA observer.

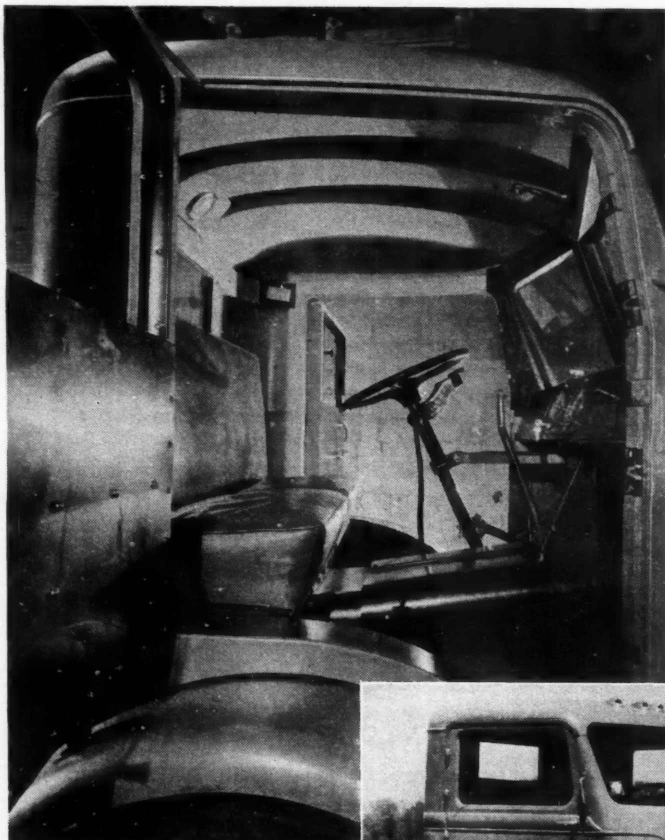
Autocar Adds 2 Models

New Short-Wheelbase Chassis Introduced for Light-Duty Operations

Two additional short-wheelbase chassis (Models UA and UB) have been announced by the Autocar Company and mark the completion of its program for the extension of its line into the light-duty field. The two new models have gross-vehicle weights of 13,500 and 16,000 lb. respectively.

Cabs of the new models are claimed to be unusually roomy and to provide plenty of leg room for a driver's assistant. This was made possible by mounting the engine lower, so that its hood, which extends back into the cab, is more out of the way. There is a heavy layer of insulation on the metal hood of the engine inside the cab. Ventilation is provided by two large ventilating doors, one directly in front of the driver, the other at the right, both of which can be controlled from the inside.

In these new Autocars, the engine can be readily exposed by releasing two latches and turning two wing nuts. The latches release the hood, which folds back on itself, thereby exposing the engine for inspection. After the two wing nuts have been released, the floor board can be lifted out, and with the hood folded back and the floorboard removed, the entire right side of the engine is accessible for the mechanic to work upon. At the right of the brake pedal there is a hinged trapdoor and when this is opened the distributor and the oil inlet are exposed.



ROOM has been provided for driver and assistant in this ventilated cab of the new Autocar short-wheelbase models, UA and UB.

ACCESS to the cabs of the new Autocar models is through rear-hinged doors. Clear vision for the driver is assured by the use of large windows.

Cabs on both models are of the regular Autocar type, with doors opening from the front, which makes it relatively easy to get into the cabs. Hinging the door at the rear makes possible a more substantial support. Access to the radiator filler is obtained through an ornamental panel at the center of the front of the cab. The ornament serves as a handle by means of which the little door is opened; it is held in the open position by springs, and when closed it is firmly held by strong springs which are claimed to prevent all possibility of rattle.

Model UA has a standard wheelbase of 84 in., but can be furnished also in wheelbases of 106 and 124 in. The side rails of its carbon-steel chassis frame have maximum cross sections of 7 15/16 by 2¾ by 7/32 in. The six-cylinder engine, of 3⅝-in. bore by 4¼-in. stroke (263 cu. in. displacement) is rated 73 hp. at 2300 r.p.m. and has such features as L-head cylinders, a seven-bearing, Tocco-hardened crankshaft, silicon-chromium-steel exhaust valves, valve-seat inserts, chrome-nickel-iron cylinder block, aluminum alloy pistons, and cadmium-nickel replaceable shell-type bearings. Lubricating oil that is continuously filtered is fed under pressure to all crankshaft, connecting-rod, camshaft and timing-gear bearings. The transmission gives four forward speeds and has provision for the installation of a power take-off. Wheels are of the cast, spoked type, of 20-in. diameter, and are regularly fitted with 6.50/20 tires, but larger size tires up to 8.25/20 can be had. The final drive is by spiral-bevel

Diesel Service to Coast Near

First regular transcontinental diesel-powered train service will be accomplished when the Baltimore & Ohio's new 3600-hp. Electro-Motive Diesel locomotives are put into operation. The first engine has been completed and is en route to Baltimore where it will be formally delivered and accepted. A second locomotive will be delivered in a few days. They will power the Capitol Limited between Washington and Chicago.

Each of the streamlined locomotives is composed of two 1800-hp. units coupled for multiple-unit operation from a single control station in the cab of the leading unit. The motive power for the 1800-hp. units—generally referred to as the "A" and "B" units—is identical and consists of two 900-hp. diesel power plants controlled simultaneously from the main locomotive throttle.

The essential units of each 900-hp. power plant comprise in general an engine with its attendant cooling, fuel and lubricating oil systems, power generator and exciter, battery charging generator, and the necessary contactors, switches and fuses for the control of electrical circuits. In addition to two such power equipments, each locomotive unit carries an 1100 gal. fuel tank and a 1200 gal. water supply for the train heating steam boiler.

The engine is a "V" type, 12 cylinder, two-cycle EMC Diesel, having an 8 in. bore and 10 in. stroke, seven bearing crankshaft, "Satco" bearings, drop-forged connecting rods, needle bearing wrist pins, aluminum pistons, lubricating oil and water pumps, and delivers 900 hp. at 750 r.p.m.

Hudson Reaches 4000 a Week

At the annual meeting of the stockholders of the Hudson Motor Car Co., held May 20 at Detroit, A. E. Barit, president, said the company production schedule was currently running at 4000 cars a week, the highest weekly rate reached in several years. Mr. Barit also told stockholders that shipments of commercial cars alone in 1937 to date have totaled 65 per cent more than were shipped during the entire year 1936.

gears with a reduction ratio of 6.80. Rear axles are of the full-floating banjo type, with single-piece housing, all bearings being of the taper roller type. The driving pinion is straddle mounted. All springs are semi-elliptic, front springs measuring 40 by 2½ in., rear springs, 53 by 3 in. The latter are provided with auxiliary springs measuring 38¼ by 3 in.

Braking equipment includes four-wheel hydraulically-actuated brakes applied by means of a vacuum power cylinder, and a hand brake acting on a drum on the drive shaft. The electrical equipment includes a vibrator-type horn, an ammeter, headlamps with non-glare lenses and parking lights, combination stop and tail lamp, dash lamps, lamp and ignition switch with key lock, generator and starter motor. All wires are carried in flexible conduit and the dimmer switch is foot-operated. Other equipment includes two cowl ventilators, a spring-type front bumper, tire carrier, spare rim, kit of tools, hydraulic jack, speedometer, oil gage, Motometer and fuel gage. The fuel tank, which has a capacity of 30 gal., is made of copper-bearing, lead-coated steel and is mounted on the right frame rail. Without the cab the chassis sells at $1,095 f.o.b. factory.

Wheelbase dimensions are the same for Model UB as for Model UA. The frame, however, is heavier (8 by 2¾ by ¼ in. section) and the engine is of larger displacement (282 cu. in.), having a bore of 3¾ in. and a stroke of 4¼ in. and being rated at 78 hp. at 2300 r.p.m.

Engine features are the same as those of the Model UA, but the transmission has five speeds, as compared with four on the UA. Tire equipment is the same as on the UA, and the spring dimensions are also the same. The rear-axle reduction is slightly greater, viz., 6.83. The four-wheel hydraulic brakes have a total frictional area of 358 sq. in., as compared with 328 sq. in. on the model UA. Items of equipment correspond to those listed for the Model UA. The UB chassis sells at $1,480 f.o.b. factory, minus the cab.

Arrowbiles to Tour Country

Studebaker Corp. has purchased five Waterman Arrowbiles, vehicles which may be flown or driven on the highways after detaching the wings, and will demonstrate them in all principal cities later this summer. The machines are powered with Studebaker Dictator motors. They are manufactured in Santa Monica, Cal.

Rubber Track Aids Performance

Marmon-Herrington Develops Three New Industrial Tractors Capable of High Road Speeds

A line of high performance track-laying industrial tractors—in three sizes—all capable of high road speed, has been developed by the Marmon-Herrington Co., Inc., Indianapolis, Ind. One of the important features of the tractor is the continuous, band-type molded rubber track reinforced by multiple strands of steel cable, developed by the B. F. Goodrich Co. in cooperation with Marmon-Harrington. Guide and drive lugs of forged steel also are permanently molded in the track. Normal track life is said to be 5000 miles.

The extremely high road speed for equipment of this type makes it adaptable for military service as well as all manner of industrial applications, such as—factory trucks, pavement and side-walk snow plows. Public utility operations such as pole boring, and for general hauling on difficult terrain.

The smallest unit of the three—Model TA-20—uses a 60 hp. V-8 power plant in combination with the four-speed truck transmission and is capable of a road speed of 32.2 m.p.h. in high gear. The next size—Model TA-30—uses an 85 hp. V-8 power plant in combination with the Ford four-speed truck transmission and is capable of a road speed of 32.1 m.p.h. The largest unit contemplated—Model TA-40 uses a 110 hp. V-12 engine in combination with the truck type four-speed transmission, and is capable of a road speed of 30.5 m.p.h in high gear.

Maximum draw-bar pull in low gear is as follows—4360 lb. at 3.0 m.p.h; 5605 lb. at 3.0 m.p.h.; and 7600 lb. at 2.7 m.p.h., respectively.

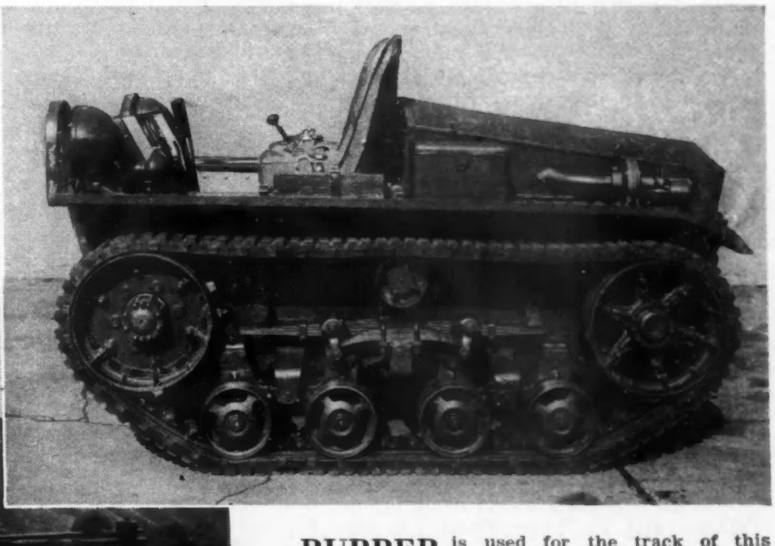
General dimensions of the three units are as follows:

Model	TA-20	TA-30	TA-40
Thread center to center on tracks	51½ in.	56 in.	65 in.
Width	61 in.	67 in.	76 in.
Length	97 in.	103 in.	117 in.
Height		51 in.	56 in.
Turning radius	6 ft., 8 in.	7 ft., 3 in.	9 ft.
Dry shipping weight	4310 lb.	5766 lb.	8020 lb.

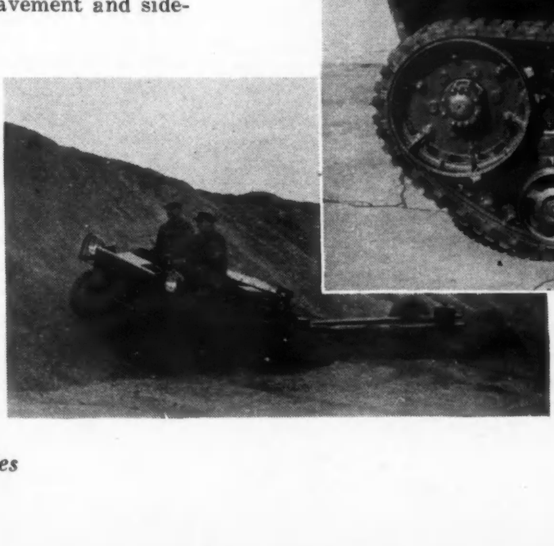
Brakes are of mechanical type on the drive line and are operated by a ratchet hand lever. The suspension is silent and easy riding under all conditions featuring a specially designed leaf spring arrangement with independently sprung track wheels. Drive is through a standard truck type rear axle.

The principal element of the structure is a rigid, water-tight hull of welded steel plate construction which carries the track and spring suspension without any other frame members. This hull houses the power plant in the rear, assuring great fording ability by protecting the engine and drive units from the action of water or dirt.

Steering is accomplished through mechanical, outside air-cooled clutches of controlled differential type, making it possible to turn the tractor by pivoting. An auxiliary compressed air booster is provided on the two larger units, giving finger-tip control of steering.



RUBBER is used for the track of this high performance Marmon-Herrington industrial tractor. It is reinforced by multiple strands of steel cable and has steel guide and drive lugs molded in. A welded, water-tight hull is the basis of the structure.



SAND PIT test undergone by new tractor to demonstrate track adhesion and stability of entire unit. Seats and controls are located forward. The power plant is at the rear, sealed to permit fording. All three models are capable of road speeds of over 30 m.p.h. in high gear.

Wide World

ROCKEFELLER, Sr. takes his first ride in a new Model A Ford at Ormond Beach, Fla., late in 1927. With him are Mr. and Mrs. Bowman. Mr. Bowman was the manager of the Jacksonville branch of the Ford Motor Co. The car was sent especially for Mr. Rockefeller's inspection.

GM May Build in East

Sloan, at Linden, Hints More Activity in New Jersey

A hint that the General Motors Corporation may establish another divisional manufacturing or assembly activity in New Jersey, as part of its announced expansion program involving the creation of 15 new plants and the expenditure of $60,000,000 was dropped in the lap of Gov. Harold G. Hoffman by Alfred P. Sloan at the ceremony marking the first month of assembly at the new Linden Division of the General Motors Corporation.

More than 500 civic officials, General Motors' dealers and divisional officials attended the ceremony which found the plant producing about 125 Buicks, Oldsmobiles and Pontiacs per day and all departments in operation, according to William S. Knudsen, president of the corporation, who followed Mr. Sloan as speaker on the dedication program. The plant has a potential capacity of 100,000 to 130,000 cars per year and that this figure may be achieved in 1938 he indicated with "business remaining about as it is."

Taxes and traffic problems are the chief obstacle to the absorption by the American public of another 5,000,000 motor vehicles in the annual inventory of registrations, according to Richard H. Grant, vice-president in charge of sales, who was another speaker on the program.

Designed by Albert Kahn, celebrated Detroit architect of automobile plants, the Linden Division covers more than a million square feet including a test track of ⅝ of a mile. There are no manufacturing operations in the plant but plenty of evidence at the dedication ceremonies that decentralization of manufacturing as well as assembly is part of the General Motors program.

Cleveland Exhibit Opens

The Great Lakes Exposition which last year drew four million people to Cleveland from all over the country, reopened May 29 with many of the country's leading industrial concerns among its exhibitors.

The Standard Oil Company of Ohio, Goodyear Tire and Rubber Company, Studebaker Corporation, Ethyl Gas Corp., Chrysler Corp., Kraft-Phenix Cheese Co., P. A. Geier Company, Medusa Products Company, National Cash Register, Ferro-Enamel Corp., Timken Roller Bearing, Railway Express Agency, Owens-Illinois Glass Co., Sherwin-Williams Co., White Motor Co., Wright Aeronautical Corp., and many other companies, have exhibits for the new lakefront fair.

Carrier Act Extension

Bill Introduced to Include Freight Forwarders

Freight forwarders may be brought under the Motor Carrier Act if Congress passes a bill introduced in the House of Representatives by Rep. B. W. Gearhart, Rep., Cal. The bill at present is in the hands of the Interstate and Foreign Commerce Committee.

Meanwhile, in New York at the first of a series of hearings being held by the Interstate Commerce Commission on safety rules for vehicles conditionally exempt from the provisions of the act, a large body of opinion was opposed to such an extension of the rules. The opposition held that the safety regulations would unnecessarily burden the carriers in question. The carriers are largely local and are at present affected by safety regulations only so far as certain employe and equipment standards are concerned. Additional rules would cover driver identification forms, extra safety accessories, accident reports to the ICC, etc.

The bill referring to freight forwarders would make them "indirect carrier operators," describing them as those who undertake to transport property for the general public for hire by utilizing the services of another carrier. Should the bill be passed, it will require the "indirect carrier operators" to apply to the ICC within 30 days for certificates. The certificate would restrict the applicant to that type of operation. They would have to file tariffs with the ICC which would be empowered to see that the charges were reasonable.

The bill is understood to have the tacit approval of the ICC.

:SLANTS:

PICTURES—*The Ford Motor Co. has asked amateur photographers to send in action pictures of 1937 Ford V-8 trucks, for which it will pay. Only pictures of trucks at work are wanted. This is probably the first instance of the amateur being invited to aid a motor manufacturer who has a huge staff of photographers on the watch for just such pictures.*

GOVERNMENT IN BUSINESS—*Bendix Products Corp. plant police may yet be UAW members, but before an election can be held to determine it, a decision must be had from the NLRB on the matter of the correctness of unionizing the men.*

ANTI-KNOCK—*Such is the demand for anti-knock fuels that the Ethyl-Dow Wilmington, N. C., plant which gets bromine from sea water is to be doubled in size. The bromine makes the motor fuel reddish in color. By-products include enough calcium to lay the*

dust on an Equator-belt road and magnesium and aluminum in sufficient quantities to build many thousands of airplanes and motor pistons.

SUNDAYS—*Detroit dealers are experimenting with the closing of their shops for business on Sundays. It is the largest city in which Sunday closings have been tried.*

Board's Rule Key to Wage Law

Reasonable administration of wage-hour legislation, contemplated in the Black-Connery bills, would not be "unduly oppressive" to the automotive manufacturers, in the opinion of those who have studied the measure. On the other hand, rigid administration of such a law would prove to be decidedly onerous.

Introduced May 24 immediately upon recommendation of President Roosevelt, the measures, almost identical, provide for a five-man Labor Standards Board which would be authorized to fix "fair hour and wage levels and to take into consideration geographical as well as competitive conditions in deciding such levels."

The automotive industries now operate on a 40-hour week basis, with time and one-half for overtime and pay the hourly wages that, with few exceptions, are the highest of all industries. The bills exempt persons earning more than $1200 a year and those earning more than 80c an hour, together with employers of fewer than 15 persons.

The bills do not relax the anti-trust laws. The only provisions which are in the nature of trade practice bar child labor and industrial espionage. Professional strikebreaking also is prohibited but this does not mean that employers are prohibited from hiring employes to replace strikers. Collective bargaining of course is required.

GM Overseas Sales Gain

Sales of General Motors cars and trucks to dealers in the overseas markets during April totaled 34,646 units, representing an increase of 18 per cent over the volume in April of last year.

In the first four months of 1937, sales of 121,303 represented an all-time high volume for that period, and an increase of 4.9 per cent over the volume in the first four months of 1936. For the 12 months through April, 1937, sales totaled 330,400 units—an increase of 8 per cent over the volume in the 12 months ended April 30, 1936.

Ford-UAW Skirmishes

(*Continued from page 787*)

Conference for Protection of Civil Rights. Invitations have gone out to Senator LaFollette and Lundeen as well as to other Congressmen and prominent speakers. The UAW is preparing to conduct a sticker campaign on automobiles and is having several thousand stickers printed with the legend "Unionism not Fordism."

Automotive Metal Markets

Steel Shipments to Plants Lag Somewhat Due to Large Parts Inventories but Total Use is Normal

Current volume of steel shipments into automotive consumption trails behind the theoretical tonnage called for by current assemblies because accumulations of parts in some plants are in excess of normal, so that they can be reduced wtihout the need for prompt replacement.

Analyzing the shipping orders of their automotive customers, steel producers have come to the conclusion that a certain amount of stocking did take place during the final period before the recent price advances. Had there been no interruptions in operations because of strikes, what now, in retrospect, looks like a building up of steel reserves, would very likely have been absorbed by the unimpaired operating rate of automobile manufacturers.

Certain it is that automotive consumption of steel has regained normalcy, absorbing, on the basis of current assembly figures, very close to 25 per cent of the entire steel output. During the period of more or less hectic steel demand, the time that mills set for promising shipment came to be accepted as one of the market's barometers, but with pressure on the facilities of the steel industry considerably lightened, more and more mills are eager to accommodate customers, making for considerable disparity in the time in which individual mills promise shipments. One producer may not care to promise shipment in less than a month or two, while another will gladly book business for shipment within a week or two.

Continuing labor troubles, together with the decision by the United States Supreme Court on the unemployment provisions of the Social Security Act, have dimmed for the time being what little hope there was of prices turning more in buyers' favor. The market's tone is very firm in spite of the gradual recession in steel demand as a whole. A mild upward readjustment in prices of certain descriptions of bolts and nuts overhangs the market, although discounts on the major items in the list have been reaffirmed for the third quarter.

Pig Iron—Shipments to automotive foundries continue in good volume. Very little interest is shown in third quarter contracts and this apathy on the part of consumers makes for the belief that the much talked of advance in prices will not materialize.

Aluminum—Imports, it was learned from belated Government reports, have been running heavy of late. In March, they aggregated more than 7,000,000 pounds, the top for any one month in recent years. The market for primary metal is steady and unchanged. Secondary metal prices unaltered.

Willys Cost Rise Shown

First positive statement of the effect on motor car cost sheets of the recent price increases in various materials was made to stockholders of Willys-Overland Motors, Inc., by David R. Wilson, president, who reported at the annual meeting that materials cost has gone up $24 a unit since the car was designed several months ago. Mr. Wilson remarked that he thought materials prices are leveling off and probably will go no higher for the balance of the model year.

Texaco Denies Charge

Answers FTC Complaint on Parts Sale Policy

Denial of Federal Trade Commission charges of promoting a so-called exclusive dealing policy and of lessening competition in the sale of automobile parts and accessories has been made by the Texas Co. in an answer filed with the commission. The commission's complaint, issued March 17, alleged violation both of Section 3 of the Clayton Act and Section 5 of the Federal Trade Commission Act.

The company said that the only parts and accessories which it has sold for resale have been lamp bulbs, oil filters, spark plugs and windshield wipers and equipment and that they have been sold in very small quantities only to the company's 4821 owned or leased service stations, where real estate or equipment is owned or leased by the company. These sales were discontinued in December, 1936. No automobile parts or accessories, the answer said in denying charges, were ever sold by or through the company to the 29,383 dealers in its petroleum products in which the company has no interest.

Questioning the jurisdiction of the commission, the company declared that substantially all sales of its petroleum products are wholly local or intrastate commerce.

The company said it never sold or distributed automobile tires or tubes or batteries for resale, although it has sold such products to the public from its company-operated service stations of which it has only about 10.

Company Earnings*

Waukesha Motor Co.		
9 mos. ended April 30		
Net income	$712,144	$381,453
Per share	1.78	95¢
Murray Corp. of America		
Net income	$357,319	$447,520
Per share	38¢	48¢
Raybestos-Manhattan		
Net sales	$6,563,189	$4,744,441
Net income	674,504	365,720
Per share	1.06	57¢
L. A. Young Spring & Wire Co.		
Net income	$483,363	$427,247
Per share	1.18	1.04
Autocar Co.		
4 mos. ended April 30		
Net income B	$252,865	$17,478 L

B—before taxes. L—net loss.
* March quarter unless noted.

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for AUTOMOTIVE INDUSTRIES

A high rate of general business activity was maintained last week, and several branches of industry registered substantial gains. The weekly index of business activity, compiled by the *Journal of Commerce*, stood at 104.1, as compared with 103.0 the week before and 91.7 for the corresponding period last year. Retail trade was retarded by unfavorable weather in some sections of the country, although the volume ranged from 8 to 20 per cent above that a year ago.

Major Indices Show Gains

Railway freight loadings during the week ended May 15 totaled 773,669 cars, which marks a gain of 6,188 cars above those in the preceding week, a rise of 92,261 cars above those a year ago, and an increase of 190,719 cars above those two years ago.

Production of electricity by the electric light and power industry in the United States during the week ended May 15 was 12.7 per cent above that in the corresponding period last year.

Lumber production during the week ended May 8 stood at 74 per cent of the 1929 weekly average. Shipments were considerably below those in the preceding week, while new orders showed a moderate decline.

Average daily crude oil production for the week ended May 15 amounted to 3,551,960 barrels, as compared with 3,489,210 barrels for the preceding week and 3,008,050 barrels below those a year ago.

Sales of 26 store chains, including two mail order houses, during April showed an increase of 10.8 per cent, as compared with those in the corresponding period last year. However, excluding the two mail order houses, the rise amounted to only about 4.4 per cent.

Wholesale Prices Up

Professor Fisher's index of wholesale commodity prices for the week ended May 22 stood at 93.5, as compared with 92.7 the week before and 93.3 two weeks before.

The consolidated statement of the Federal Reserve banks for the week ended May 19 showed declines of $1,000,000 each in holdings of discounted bills and bills bought in the open market. Holdings of Government securities remained unchanged. The monetary gold stock rose $25,000,000, and money in circulation declined $6,000,000.

Selection tables and textual advice on **grinding procedure** is contained in the "Grinding Wheel Data Book," published by the Abrasive Co., division of Simonds Saw and Steel Co.*

Studies of **services performed by** and the position in business of the motor industry have been written by the National Highway Users Conference. The work is titled "Economic and Social Values of the Motor Vehicle."*

Progress in constructing motor vehicle for the special use of **public utility** companies is outlined in a booklet published by the American Coach & Body Co., called "Standard Public Utilities Equipment."*

A complete catalogue of Hercules engines and power units together with **performance tables** is offered by the Hercules Motors Corp.*

Methods used by **accident prevention** bureaus in various cities are described in a booklet by the International Association of Chiefs of Police and the Northwestern University Traffic Safety Institute.*

An interesting study of correct methods for **grinding, polishing, and buffing** of welds in stainless steel parts is a feature of the May issue of **Oxy-Acetylene Tips.**

* Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

Ford, Ltd., Exports Large

Sir Percival Perry, chairman of the Ford Motor Company, Ltd., said at the annual meeting that 27.62 per cent of the motor vehicles exported from Great Britain last year were of Ford manufacture. In 1935 the percentage was 30.34 and in 1934 it was 16.94.

Referring to the expansion of British Ford production, Sir Percival said that the average number of employees at the Dagenham plant, near London, had increased from 6780 in 1934 to 11,567 in 1936. New buildings in course of erection, he added, would provide 29 acres (43,560 sq. ft.) of machine and assembly shops under one roof, while foundry facilities would be more than doubled. A new steel rolling mill and spring department have been completed and are now in full operation.

Speaking of the Ford policy of endeavoring to bring motor transport within reach of an ever-increasing section of the public, Sir Percival expressed the opinion that if the laws of supply and demand were allowed to prevail it would be many years before even half of the natural demand for automobile transport would be supplied.

Brown is Briggs President

Walter P. Brown has been elected president of the Briggs Mfg. Co. to succeed Walter O. Briggs who continues as chairman of the board. W. Dean Robinson was elected vice-president and was appointed assistant general manager. He is a son-in-law of Mr. Briggs. E. E. Lundberg, who has been chief engineer, becomes vice-president in charge of engineering. F. J. Kennedy, who has been manager of the Detroit plants, becomes vice-president in charge of manufacturing. A. D. Blackwood, controller, becomes assistant secretary and assistant treasurer.

Use Rubber Substitutes

Crude Price Rise Brings Use of Reclaimed, Synthetic

The rise in crude rubber prices during the past several months not only has accelerated the use of reclaimed rubber in the United States but has materially stimulated the development of synthetic rubber by at least two foreign countries—Russia and Germany—with Germany planning extensive production of synthetic rubber, according to Everett G. Holt, chief of the rubber-leather division of the Commerce Department, Washington, addressing members of the Akron Export Club in Akron, O. Mr. Holt stated that Germany has imposed an import tariff of 22½ cents a pound on crude rubber and will use the tariff revenues for the building of large synthetic rubber plants. Russia's imports of natural rubber, he stated, are on the steady decline while production in Russia of synthetic rubber and semi-rubber plastics increased from approximately 11,000 tons in 1934 to approximately 40,000 tons in 1936.

Synthetic rubber in Germany, it is understood, costs approximately three times as much as natural rubber. In the United States the du Pont synthetic rubber known as Neoprene sells at approximately 75 cents a pound, against a natural rubber price of 21 cents.

Ex-Cell-O Shortens Title

Stockholders of the Ex-Cell-O Aircraft and Tool Corp., have authorized a change in the corporate name to Ex-Cell-O Corp.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

Winton Holds the Record

On Decoration Day, May 30, the Winton motor carriage gave an exhibition mile against time on the race track at Cleveland, Ohio, making a mile on a circular track in one minute and 48 sec. and breaking all previous records.

In just 60 days after the organization of the company the first new and improved carriage was turned out. It was given a road test from Cleveland to Elyria and return and proved its perfect utility for every purpose to which a horse and wagon can be put.

The Winton motor carriage resembles an ordinary trap with the seats back to back, each wide enough to seat three persons comfortably. The motor and driving mechanism are snugly concealed in the body of the vehicle and are self-lubricating. The body is supported on easy riding springs. It will be provided with a canopy top when ordered. The weight of the entire machine is 1800 lb.

The 10-hp. motor of the hydro-carbon type is said to be compact, practically noiseless, odorless and free from vibration. It uses gasolene, which the patent feeder converts to a fixed gas before entering the cylinders without any carburetor.

—From *The Horseless Age*, May, 1897.

UAW Dues Seen Chief Cause of Tension

(*Continued from page* 789)

ditions or any other element of relationship between managements and individual men. Nor has it anything to do with collective bargaining nor recognition of the UAW as an agency with which to bargain. It stems almost exclusively from union need for the closed shop and the check-off to insure union income. The real genesis of current production-stoppage threats is the inability of union officials to maintain income on the basis of voluntary memberships.

Some forty-odd strikes in General Motors plants, a recent strike by 250 paint shop workers at Hudson and last week's short-lived flare up at Studebaker, when a group of final assembly operators staged a "wildcat" walkout, furnish recurring examples of the inability or unwillingness of union officials to live up to promises or agreements already made. Similar strikes or tacit threats of strikes are current throughout scores of automotive plants in which managements have been working regularly and sincerely with UAW shop committees. Meetings are held every morning in some instances.

What the outcome of present turmoil will be can scarcely be foretold. A poll of competent observers would indicate a majority belief that:

1. Collective bargaining on a formalized basis has come to stay.
2. The bargaining agency representing employees in any given case eventually will have to be both competent and willing to fulfill its agreements—or be forced finally to legal responsibility for its agreements and actions.
3. Failing achievement of the closed shop and the check-off, present UAW dominance in the automotive field may reach its peak within the next twelve months, because too large a proportion of its present membership has been procured on a somewhat involuntary basis.
4. The chances of the UAW attaining its closed shop ends are remote because an overwhelming majority of large employers will, even under pressure of immediate circumstances, refuse to permit permanent principles to be obscured by opportunistic action.

AUTOMOTIVE INDUSTRIES

Looking Ahead

NEXT WEEK: we present the fourteenth and fifteenth articles in the series devoted to manufacturing details in motor-vehicle plants. Subjects—Borg & Beck and Federal Truck—two shorter articles instead of the usual long one.

ENGINE DRAWINGS: we have received from several of our foreign correspondents an interesting selection of foreign engine designs, covering the passenger car, truck and aircraft fields. Publication of the series will be continued indefinitely, and requests for back numbers containing the drawings will be filled wherever possible.

LETTERS to the editor, in which you mention subjects of special interest to you and what things in the magazine appeal to you most, are helpful, and constructive suggestions will be utilized whenever possible.

Studebaker Men Return Under Union Contract

(*Continued from page* 789)

"Third: Between the president or vice-president of the union and either the general superintendent, industrial relations director or both.

"Fourth: Between the negotiating committee and production manager, general superintendent, industrial relations director.

"Fifth: Between the negotiating committee and company officials, production manager, general superintendent, industrial relations director.

"Promotion to better jobs within the department shall be made from the ranks of those qualified employes within that department whenever possible.

"It is agreed that in case of strike, employes in the plant protection, power, and building maintenance department may be kept at work, but only to the extent that they are necessary for the proper protection of the company's property.

"During the tenure of this agreement, no lockout shall be inaugurated by the company and the union shall not allow any of its members to strike."

Cancellation of the contract may be effected after 30 days' written notice, and strikes are to be prevented during the notice period.

Hudson Motor Car Co. and subsidiaries reported net profit of $7,234 for the three months ended March 31, 1937.

Calendar of Coming Events

SHOWS

Morocco, Automobile Section, Tangier Fair, Tangier .... June
France, Automobile Section, Bordeaux Fair, Bordeaux .... June 13-28
Belgium, First International Aeronautical Salon, Brussels .... June 18-30
Fourth ASTM Exhibit of Testing Apparatus and Related Equipment, New York .... June 28-July 2
Second Winter Item Show, Automobile Accessories Association, Chicago, Aug. 9
Poland, Automobile Salon (Foire Orientale), Lwow .... Sept. 1-15
Yugoslavia, Automobile Section, Autumn Fair, Ljubljana .... Sept. 1-12
Yugoslavia, Automobile Section, Commercial Fair, Belgrade .... Sept. 11-21
France, 31st International Automobile Salon, Paris .... Oct. 7-17
Great Britain, 31st International Automobile Exposition, London .... Oct. 14-23
Czechoslovakian Automobile Show, Prague .... Oct. 16-24
National Automobile Show, New York, Oct. 27-Nov. 3
Toledo, O., Automobile Show .... Oct. 27-Nov. 3
Italy, 10th International Automobile Salon, Milan .... Oct. 28-Nov. 8
Buffalo, N. Y., Automobile Show, Oct. 30-Nov. 6
Cincinnati Automobile Show .... Oct. 31-Nov. 6
Great Britain, 13th International Commercial Automobile Exposition (trucks and buses), London .... Nov. 4-13
Chicago Automobile Show .... Nov. 6-13
Akron Automobile Show .... Nov. 6-12
Omaha Automobile Show .... Nov. 6-11
Brooklyn Automobile Show .... Nov. 6-13
Columbus Automobile Show .... Nov. 6-13

Show Business

Manager of the National Automobile Show in New York is Alfred Reeves, 366 Madison Ave., N. Y. C. Inquiries concerning all matters connected with the national show should be addressed to him. AUTOMOTIVE INDUSTRIES will be pleased to furnish names and addresses of local show managers on request.

Detroit Automobile Show .... Nov. 6-13
Kansas City, Mo., Automobile Show, Nov. 6-13
Motor Truck Show, 4th Annual, Newark, N. J. .... Nov. 6-12
Newark, N. J., Automobile Show .... Nov. 6-13
Philadelphia Automobile Show .... Nov. 6-13
Pittsburgh, Pa., Automobile Show .... Nov. 6-13
Toronto, Ont., Automobile Show .... Nov. 6-13
Great Britain, 36th Scottish International Automobile Exposition, Glasgow .... Nov. 12-20
Baltimore, Md., Automobile Show, Nov. 13-20
Cleveland, Ohio, Automobile Show, Nov. 13-20
Jersey City, N. J., Automobile Show, Nov. 13-20
Milwaukee, Wis., Automobile Show, Nov. 13-20
Springfield, Mass., Automobile Show, Nov. 14-20
St. Louis, Mo., Automobile Show .... Nov. 14-21

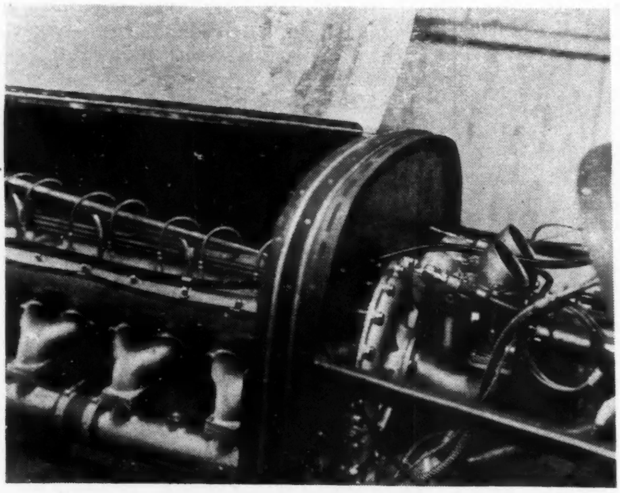
CONTESTS

Indianapolis Speedway, 500-Mile International Sweepstakes .... May 31
31st Annual Grand Prix of the Automobile Club of France, Linas-Monthléry .... July 4
Roosevelt Raceway, 300-Mile George Vanderbilt Cup Sweepstakes (Rain date July 5) .... July 3
National and International Soap Box Derby Finals, Akron, Ohio .... Aug. 15
Pan American Cup Race, Roosevelt Raceway .... Sept. 6
National Outboard Championship Regattas, Richmond, Va. .... Sept. 18-19

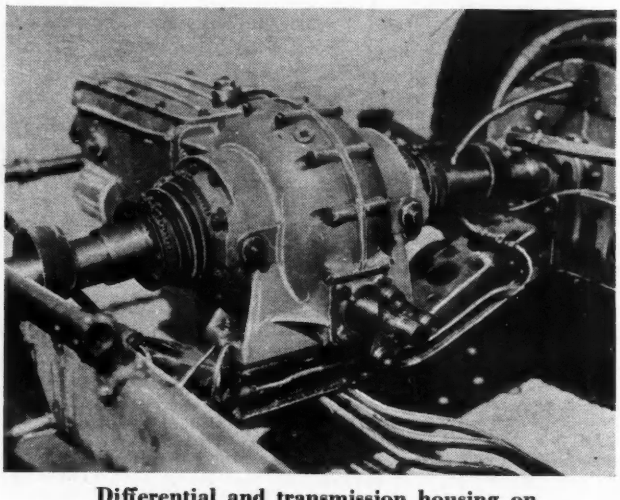
CONVENTIONS AND MEETINGS

American Petroleum Institute, Mid-Year Meeting, Colorado Springs, Colo. .... May 31-June 3
Second World Petroleum Congress, Paris, France .... June 14-19
Automotive Engine Rebuilders Association, 15th Annual Convention, Chicago .... June 21-24
American Society for Testing Materials, 40th Annual Meeting, New York, June 28-July 2
U.A.W. Annual Convention, Milwaukee, Aug. 23
American Transit Association, 56th Annual Convention, White Sulphur Springs, W. Va. .... Sept. 19-23
S.A.E. Fuels and Lubricants Regional Meeting, Tulsa, Okla. .... Sept. 30-Oct. 1
S.A.E. National Aircraft Production Meeting, Los Angeles, Calif. .... Oct. 7-9
S.A.E. Annual Dinner, Commodore Hotel, New York .... Oct. 28
American Petroleum Institute, 18th Annual Meeting, Stevens Hotel, Chicago .... Nov. 9-12
S.A.E. National Production Meeting, Flint, Mich. .... Dec. 8-10

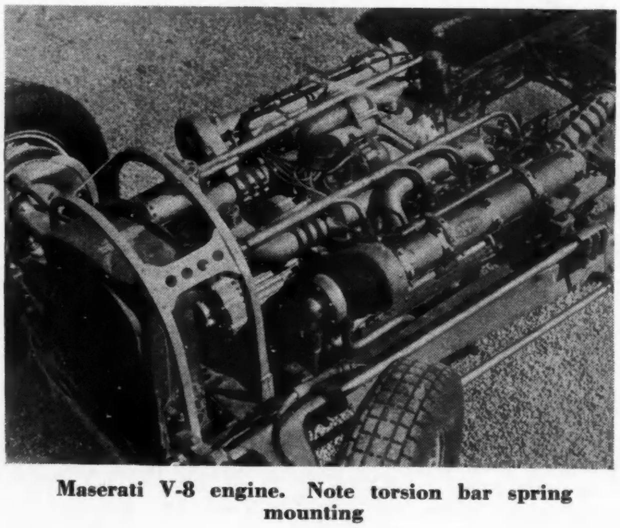
The Bricks Get Hotter and



Supercharger on Hartz Miller 8 chassis with twin carburetors



Differential and transmission housing on Maserati



Maserati V-8 engine. Note torsion bar spring mounting

By Chester S. Ricker

THIS 25th Silver Anniversary running of the 500 mile International Sweepstakes race on the Indianapolis Motor Speedway, will probably be the fastest race, weather permitting, that has ever been held at Indianapolis. Already, Jimmy Snyder has done 130.492 miles per hour for a lap, Harry McQuinn 126.476 and Wm. Cummings 125.139. The first two cars have superchargers.

New rules this year and better preliminary preparation of the cars indicate this. The early qualification trials, May 15 and 16, evidenced the possibilities, for more cars were qualified the first day, more drivers were ready for trials and all speed records for the track were lowered by substantial margins.

Abolishing the fuel limitation that has been in effect since 1934 has changed the complexion of the entire race. Last year it was fuel economy which worried the drivers, this year it is tires. That some drivers had good reason to worry about fuel consumption was shown by the results. Seven ran out of fuel, three in the last 20 miles when holding 4th, 6th and 8th places, respectively. They were Cantlon, Mays and MacQuinn, all of whom are in this year's race with faster cars.

The most important point in the 1937 rules reads "*FUEL SUPPLY is not limited, but the use of commercial gasoline is mandatory.*" Commercial gasoline is "defined as a bona fide commercial gasoline of a brand or trade name at least one year old prior to May 1, 1937, which is normally used and normally sold through regular outlets in the continental U. S. A. for use in automotive road vehicles." The entrant had to elect the brand to be used eight days before the first qualification trials and must use that fuel in both trials and the race. Samples are taken before each qualification trial. They are also to be taken before, during and after the race for analysis. A complete laboratory has been set up at the track for making fractional distillation tests and checking the "Octane Knock Rating." The Ethyl Gas Corporation type of Knock Test Engine is available at the track for this purpose. After the race Louis Schwitzer, chairman of the technical committee, may fly the finishers' fuel samples to the Standard Oil Company of Indiana's laboratory at Whiting, Ind., where mass testing can be done in a very few hours.

There is a proposed Economy Prize this year, too, and any entrant electing to compete for this prize will be allowed a maximum of 45 gal. the same allowance as in the 1934 race.

However, there are two distinct economy features in this race that are not evident to the public. One is a limit of six gallons for engine lubricating oil supply. No more may be added during the race. The other is the use of 15 gal. fuel tanks on all cars. The car weights are set at a minimum of 1800 pounds without fuel, oil or water. Engine displacement remains limited to 366 cu. in. maximum. Superchargers are allowed for the first time since 1929.

Let's analyze what effect these rules have had on the

Hotter at Indianapolis

With speeds on the tryouts exceeding 125 m.p.h. and new rules conducive to faster driving, the 25th Anniversary Race bids fair to make history

cars. Only nine cars out of the 50 entered have superchargers and the two fastest cars that qualified on the first day, i. e., Wm. Cummings' and Wilbur Shaw's both have unsupercharged 4 cylinder 255 cu. in. Offenhauser engines with overhead valves and double camshafts. The third car, Ardinger's has a Miller of similar design and the same displacement but with a supercharger. The most interesting thing about the engine changes is the reduction of compression ratios from as high as 14 to 1 down to something between 7 and 8 to 1. Each driver has varied his compression to suit individual engine conditions since ignition, carburetion and manifold design have such an important bearing on it. Piston heads in most of the overhead valve engines have been cupped out so as to increase combustion chamber volume without changing the cylinders. This, of course, was dictated by economy. Only pistons have to be changed to convert last year's engines to this year's rules and fuel.

When the rules were made, I think most of the committee felt that allowing regular commercial fuels to be used this year was justified because they could not be burned as efficiently as the super-fuels used in 1936. Therefore, horsepower would fall off and speeds would be lower and the race safer. Before me I have the results of the first week's trials. (Table 1.) Only one of these first 12 cars to qualify had a supercharger. All except one, Louis Meyer's, had 4-cylinder engines. All have duel overhead camshafts and valves in the head. Two are new this year. Half are Offenhauser and half Miller design. What is most remarkable is the great increase in speed obtained from these comparatively low compression racing engines designed to run on standard commercial fuel. To show this improvement in engine performance it is only necessary to compare the 1937 performance of the same 10 cars which qualified in 1936. The average improvement was nearly 5 m.p.h. The best improvement was that of Cummings, 8.5 miles an hour better. That means a lot when you start at a 116 m.p.h. average for the 25-mile test last year. Also these cars had to make their qualification trials with race-day equipment, such as fuel, oil, rear-axle gear ratio, tires and wheel size. Formerly a low-gear ratio could be used for qualification and a higher one on race day.

There are a good many theories about the higher speed this year. Is it the great power being obtained from the engines under the unlimited fuel rule, change in design of cars or the track? The older drivers think it is the track. The turns are now all smoothed out with rock asphalt laid over the bricks. The bumps which caused cars to lose traction and get out of hand are gone. Some cars tour the turns at over 110 m.p.h. One driver told me that he had trouble making 114 m.p.h. average for 25 miles last year. This year he made his fastest lap at over 120 m.p.h. with the same car. Last year he carried a 15-to-1 compression ratio and his engine turned 5400 revs. at maximum speed. This year with a 7.5-to-1 compression ratio 4600 to 4900 revs. were the best he could do. His rear-axle ratio was higher to compensate. His experience pretty surely confirms the fact that the track is a good five miles an hour faster than ever before.

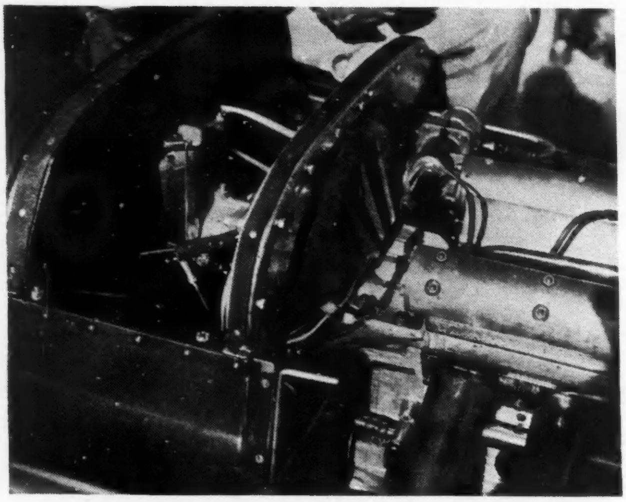
This faster track, however, is not such a boon. It is so easy to go fast that tire wear is of serious concern to the drivers. At the speed Cummings ran on the record break-

Table I—1937 and 1936 Comparison of Qualification Speeds

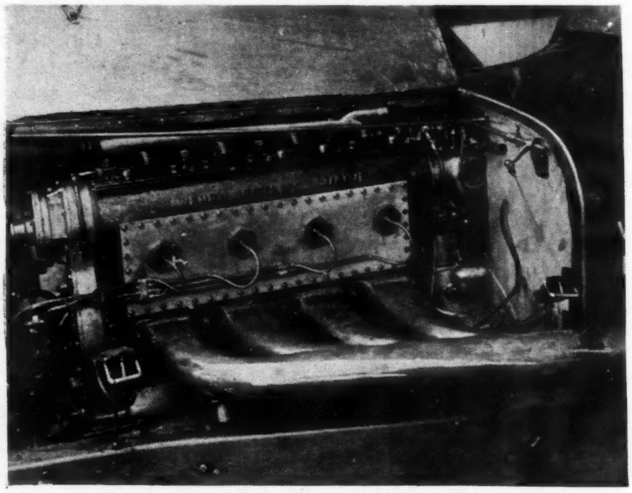
No fuel limitation in 1937. Arranged in starting order.

Start Pos.	Car No.	Driver's Name	1937 10 Lap Av. M.P.H.	1937 Fastest Lap M.P.H.	1936 10 Lap Av. M.P.H.	Difference M.P.H.	Make of Engine	Displ. Cu. In.	No. of Cyl.
1	16*	Bill Cummings.....	123.445	125.139	115.939	7.506 more	O	255	4
	Previous track records		120.736	124.018					
2	6	Wilbur Shaw.......	122.751	123.525	117.503	5.248 more	O	255	I
3	54	Herbert Ardiner.....	121.983	123.423	115.082	6.901 more	M	255	4
4	10	"Billy" Winn.......	119.922	120.789	114.648	5.274 more	M	255	4
5	2	Louis Meyer........	119.619	121 622	New car	New car	M	269	8
6	8	Ralph Hepburn.....	118.809	120.064	114.171	4.738 more	O	255	4
7	38	Tony Gulotta.......	118.788	119.554	112.403	6.385 more	O	255	4
8	1	Maury Rose........	118.540	119.158	113.996	4.544 more	O	269	4
9	31	Chet Gardner.......	117.342	118.033	116.000	1.342 more	O	255	
10	23	Ronnie Householder	116.464	117.264	New car	New car	M	233	4
11	35	Deacon Litz........	116.372	117.157	115.997	0.385 more	M	225	4
12	17	Geo. Connor........	120.240	120.968	116.269	3.971 more	M	262	4
13	7	Chet. Miller........	119.213	120.530	117.675	1.538	M	155	8*
14	28	Wm. De Vore.......	118.694	120.192	New Car	New Car	M	255	4
15	24	Frank Brisko.......	118.213	119.079	New Car	New Car	Own	350	6
16	45	Cliff Bergere.......	117.546	118.110	116.221	1.325	O	255	4
17	62	Floyd Roberts......	116.996	117.632	116.703	0.293	M	269	4
18	53	Louie Tomei........	116.437	117.188	New Car	New Car	S	336	8
19	5	Jimmy Snyder......	125.287	127.155	....	....	S	337	6
20	25	Kelly Petillo........	124.129	125.418	116.961	7.168 more	O	318	4
21	33	Bob Swanson.......	121.920	122.582	119.644	2.276 more	O	269	4
22	47	Harry McQuinn....	121.822	124.740	....	....	M	247	4
23	14	Rex Mays..........	119.968	120.805	....	....	AR	232	8
24	32	Floyd Davis........	118.942	119.792	....	....	M	255	4
25	34	Shorty Cantlon.....	118.555	119.792	116.912	1.643 more	M	234	4
26	42	Al Miller..........	118.518	119.713	....	....	M	255	4
27	26	....	118.242	118.640	113.890	4.352 more	..	...	.
28	22	Joe Thorne........	115.602	116.747	118.945	3.343 less	O	222	4

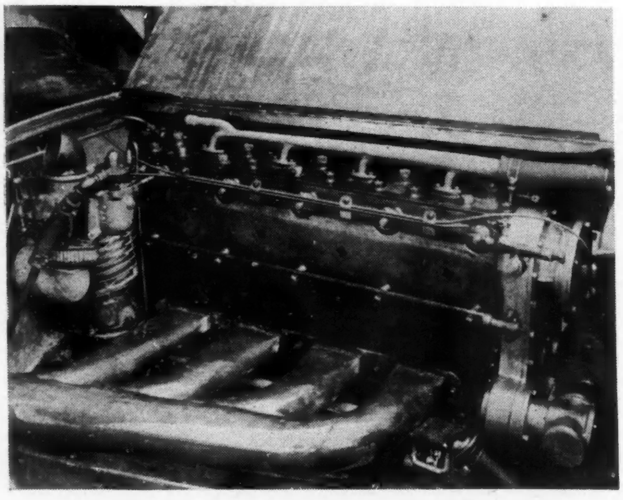
N. B.—Only No. 54 Car in third starting position has a supercharger. S—Sparks. AR—Alpha Romeo.
Average Increase in Speed—4.729 M—Miller O—Offenhauser *—Front Wheel Drive



Sparks Sp. showing horizontal carburetor attached direct to supercharger



There are two entries powered by Wehr rotary valve two-cycle engine



Root Blower on Wehr rotary valve two-cycle engine

ing trial that gave him the pole—at speeds over 120 m.p.h. and probably 150 or better on the stretches—his right front tire was so badly worn that had he kept up the race it is doubtful if he could have run 50 miles before changing. Being a front-wheel drive his right front took the punishment. The rear-wheel drives get it on the right rear. Last year tire changes were made at the first fuel stop by seven of the first 10 place winners. Right rear being changed on rear wheelers and right front on the front drive type. Two of the first 10 went through 500 miles without a tire change. Furthermore only two of the first 10 made more than the necessary two fuel stops. The question now worrying all the drivers is this—How fast can they drive without needing a tire change before their first fuel stop? When is it best to stop for fuel? One hundred seventy miles or 68 laps is the minimum distance allowable for a two-stop race. With 15 gal. tanks that is an allowance of 11.3 miles per gallon—more than enough to carry most of these cars at a 112 m.p.h. pace had they chosen so to run last year. At least that could be deduced from Table 2. But this year it is doubtful if they will get 10 miles per gallon at the same speed.

They will run faster than in 1936. Assume only nine miles per gal. can be obtained at 118 m.p.h. Would it pay to drive at that pace and refuel three times instead of twice? You could run 130 miles or 52 laps to the first stop. The question then would be—Will the tires stand up that long? The general rule in the 500 mile race is that every stop costs about one mile an hour in the average. Each stop averages about 2 minutes 30 seconds loss in running time. This is one race in which the good judgment of the team manager is going to mean a great deal more than it has in the last three years when everyone was held down to a pretty definite pace by the fuel limitations.

The most interesting new cars at Indianapolis include, of course, the Italian Alfa Romeo Straight 8, the Maserati V-8, the new Sparks "Six," the fastest car ever to encircle the speedway, the rear-engine car designed by Lee Oldfield and powered with a Marmon V-16 engine and the Kimmel with a V-12. The Alfa Romeo and Maserati cars were described and illustrated in the Oct. 10, 1936, issue of AUTOMOTIVE INDUSTRIES. The Sparks "Six" Special, driven by Jimmy Snyder has 337 cu. in. displacement, Brisko's six 350 and the Marmon V-16 365 cu. in., the largest engine entered in the race. Snyder's engine is supercharged with a centrifugal blower driven off the rear end of the engine and fed from a horizontal outlet Winfield carburetor but the supercharger may have to be removed since the engine seems to overheat with the cooling surface now available. The valves are overhead and operated from two overhead camshafts. The car is unusually low and the body is streamlined behind the driver's head. European type brakes are used having large holes in the carrier plates to lighten the unsprung weight and ventilating scoops to direct air to the shoes and inside the drum. The brake drums are also unusually well ribbed for cooling and stiffening.

The Lee Oldfield car is the lowest car on the course. It may not be ready in time to qualify for the race, but in experimental runs it looks as though it had many meritorious and unique features. It is the only American car with all four wheels independently sprung. The rear wheels are driven by separate transverse drive shafts from the differential which is housed in the gear case back of the engine. The power unit is forward of the rear wheel center line. The brake drums are on either side of the differential and brake through the dual propeller shafts. This gives the minimum unsprung weight. The front suspension is apparently the standard Packard Safe-T-Flex design applied to the body of this car, for there is no chassis or frame in the conventional form. Only a radiator is placed ahead

TABLE 2
1936 500 Mile Race Averages

Position	Car Name	Driver's Name	Time	Average Speed M.P.H.	Average Pit Stops Out M.P.H.	Gallons Fuel Used	Average Mile Per Gallon
1	Ring Free Special	Louis Meyer	4-35-03.39	109.069	110.09	34.59	14.455
2	Hartz Special	Ted Horn	4-37-20.54	108.170	109.90	35.63	14.03
3	Gilmore Speedway Special	Doc McKenzie	4-39-10.36	107.460	109.50	37.00	13.51
4	F. W. D. Special	Maury Rose	4-39-39.85	107.272	108.31	36.63	13.65
5	Boyle Valve Special	Chet Miller	4-40-35.17	106.919	108.30	37.50	13.33
6	Fink Auto Special	Ray Pixley	4-45-01.58	105.253	106.50	36.00	13.89
7	Gilmore Special	Wilbur Shaw	4-47-49.00	104.233	111.35	33.47	14.94
8	Shafer Special	Geo. Barringer	4-52-18.65	102.630	106.00	34.375	14.55
9	Boyle Products Special	Zeke Meyer	4-56-03.57	101.331	103.60	35.50	14.06
10	Marks Millers Special	Geo. Connors	5-03-14.49	98.931	104.50	37.16	13.46
11	Midwest Red Lion Special	Fred Winnai	Flagged at 199 laps 98. estimated			35.87	13.94

Rex Mayes No. 33	1st Lap	1-17.60	115.98 m.p.h.
Gilmore Special	2nd Lap	2-32.44	118.07
	4th Lap	5-04.69	118.15
	2nd Lap	1-14.84	120.25

of the driver. An automatic two-speed transmission is used. Centrifugally operated clutches engage the proper speed gear.

Looking over the field of entrants it is particularly interesting to note the preponderance of the 4-cylinder type, 64 per cent to be exact. Eights are the next largest class accounting for 30 per cent of the field. Of these 4 per cent are of the "V" type. For the first time in many years the 6 cylinder gets the "spotlight." There are only two entered in the race, one driven by Snyder the other by Brisko. Both have large displacement engines, the largest next to Oldfield's V-16. Snyder has been repeatedly making over 130 for his laps and Brisko did a top speed lap of 119 when he qualified. However, the first 18 qualifiers included 14 fours, 3 eights and one six, nine with Miller engines, seven Offenhauser, one Studebaker and one Brisko.

This might have been expected since there are 20 Miller engines entered, 11 Offenhauser, four Studebaker, two Buick, and one each of Sparks, Packard "120," Alfa-Romeo, Maserati, Cragar, Duesenberg, Marmon, Brisko, McDowell, Voelker and Wehr. The Studebaker and Packard have "Ell" head engines, the Wehr a rotary and the rest valves in the head. The Buick and the Marmon have a single camshaft in the crankcase, the valves being operated by push rods and rocker arms. The majority of the other cars have dual camshafts placed directly above the valves. To get maximum power without a supercharger the Studebakers all have four carburetors each feeding a pair of cylinders. The same is true of the new Brisko six where three carburetors are used. The only difference being that a common manifold is used on the six and four independent manifolds on the Studebakers. The Snowberger Packard is a front-wheel drive so that it is easy to apply the supercharger drive to the end of the crankshaft which extends into the driver's compartment.

Engine size don't seem to be the most important factor in winning a 500-mile race. Last year an 8-cylinder 182-cu. in. Miller driven by Ted Horn took second place. The smallest engine in the race is another 8-cylinder Miller with front drive and only 155 cu. in. displacement. At one time two years ago this car led the race, last year it finished fifth and in this year's qualifications it made over 120 miles per hour for a lap. How like a race horse and sensitive to touch these race cars are was demonstrated during the first day's trials this year. Chet Miller with this little "humming bird" was running well over 118 on his first trial when a fire started in one of the concession stands and the fire apparatus was allowed to come out on the track. He shut off so suddenly that his cylinders cracked and it was not until the second series of trials before he could make a second trial. The sudden reduction in cylinder temperature was the reason given for the trouble.

Superchargers next to tires are causing the greatest comment at the track. They are not new but have not been used at the Speedway for 10 years because the rules prohibit them. Their newness has brought a lot of problems to the present crop of drivers who either have had no experience with them or have forgotten the troubles that they had with them in the past.

There are three types of supercharger used: centrifugal, rotary vane and Root's Blower. The first is the most popular and is made in two forms, one with vertical drive shaft and the other with horizontal shaft. The vane type is found on the Marmon V-16 engine and placed directly above the differential housing behind the cylinder block.

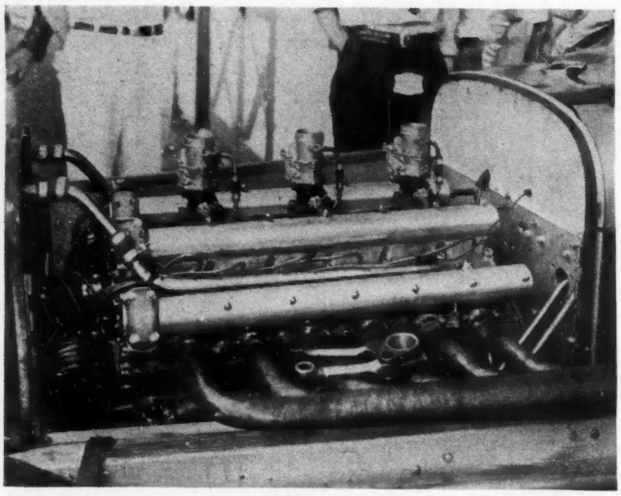
The Roots type is found on the Maserati, located in front of the engine and driven from the crankshaft, the Wehr two-cycle engine has it at the rear of the engine and is driven by an inclined shaft instead of a horizontal one. The carburetor is placed outside of the blower to the right side of the car. A short elbow connection from the blower outlet connects to the rear end of the hollow rotary inlet valve which is located directly above the cylinders.

The centrifugal type of supercharger is driven in two distinct ways, depending upon the type of installation and position of the rotor blower. Duray has two cars and Snowberger another that have the vertical rotor axis. They are driven by bevel gears from the end of the crankshaft. They are at the front on the rear-wheel drive jobs and at the rear on the front-wheel drives. This type is made by the Schwitzer Cummings Co. and includes one of the most ingenious step-up drives. Instead of a planetary step-up gear it provides a series of ground rollers arranged just like a planetary gear. It depends upon friction to drive the rotor. Apparently this is enough to cushion the shocks due to changes in engine speed. These blowers carry a downdraft single or dual carburetor mounted directly on top of the rotor housing. The discharge is to a long manifold feeding all cylinders in common.

The Miller type engines all have a horizontal rotor shaft and are driven through a train of spur gears from the back end of the engine. Most of them are located in the dash of the body and have the carburetor under the cowl. They are all housed so that although they are behind the dash there is a fire wall between the carburetors and the driver's cockpit. The Snyder Six has a single horizontal outlet Winfield carburetor feeding this supercharger direct.

TABLE 3
Engine Displacements

Number of Entrants	Piston Displ. Cubic Inches
13	255
4	269
3	250
2 each	213-220-256
1 each	(8) (8) 155-182-215-221-222-225-232-233-234-238-246-247-258-262-263-282-294-305-318-332-336-337-350-365-misc.



Voelker V-12 showing four camshafts and one of its hinged connecting rods laid on exhaust pipe

Some of the other engines have it connected by a combined manifold, "Y," in some cases and horizontal in another where the downdraft carburetors are attached to each end of the manifold.

It is amazing to figure out what some of these superchargers are doing. On one engine the gear ratio or step-up between the crankshaft and rotor shaft is 4.86 to 1. This engine has an average top speed of 7000 r.p.m. At this speed the supercharger impeller is turning almost 35,000 r.p.m. This particular one has a diameter of 7.5 in. and thus at high has a peripheral speed of over 13 miles per minute. Needless to say they make the rotors of an aluminum alloy. This particular one delivers about 10 lb. pressure above atmosphere. In operation, the driver tells me, it acts like a retarded spark until a certain critical speed is past and then it becomes a "fire cracker."

Handling the shock loads due to sudden changes of engine speed is a very important part of this supercharger problem. On some of the engines rubber blocks are placed in the hub of the primary drive gear, just as the springs are placed in the hub of most modern passenger car clutches. On another engine a series of radial steel springs clamped in the driving hub and meshing with internal teeth or slots in the driving gear ring provide the necessary flexibility.

On the several of these engines New Departure fully sealed ball bearings are used at the center of the rotor. Their use is very important for the proper function of the blower. There is a high suction on the back side of the rotor center and if it were not for the use of these bearings oil would be drawn from the gear case into the intake manifold.

On two of the supercharged units I observed that oil was fed to the gears and that the oil so used was carefully cooled by a heat radiating coil located on the dash and

The Men, The Cars and

Car No.	Car Finish Pos. 1936	Driver's Name	Car Name	Entrant	Engine Make	No. Cyl.	Boro Inches	Stroke Inches	Piston Disp. Cubic Inches	Engine Type and Valve Pos.	Carb. Make	Carb. No. of Type of	Ign. Make	Ign. Cable
1	185L	Mauri Rose	Burd Piston Ring Spl	Lou Moore	Offen	4	4.315	4.625	269.6	OHC	Miller	2U	BoM	Pak
2	NE	Louie Meyer	Boyle Spl	M. J. Boyle	Miller	8	3.379	3.750	269	OHC	Win	4D	BoM	Pak
3	2P	Ted Horn	Hartz Spl. FD	Harry Hartz	Miller	8	2.875	3.500	182	OHC	Win	2	BoM	Pak
5	NE	Jimmy Snyder	Sparks Spl	Joe Thorne	Sparks	6	3.875	4.750	337	OHC	Win-Horz	1 Horz	BoM	Pak
6	7P	Wilbur Shaw	Shaw Gilmore Spl	Wilbur Shaw	Offen	4	4.250	4.500	255	OHC	Win	2	BoM	Pak
7	5P	Chet Miller	Boyle Spl. FD	M. J. Boyle	Miller	8	2.656	3.500	155	OHC	Win	4	BoM	Pak
8	1P	Ralph Hepburn	Hamilton Harris Spl	Louie Meyer	Offen	4	4.250	4.500	255	OHC	Win	2U	BoM	Pak
10	78L	Billy Winn	Miller Spl	James M. Winn	Miller	4	4.250	4.500	255	OHC	Miller	2U	BoM	Pak
12	NE	Russ Snowberger	R. & S. Spl. FD	Snowberger	Packard	8	3.250	4.250	282	L hd	Win	2D	BoM	Pak
14	NE	Rex Mays	Bowes Seal Fast	Bill White, Inc	Alfa Romeo	8	3.071	3.937	232	OHC	Win	2	BoM	Pak
15	NE	Babe Stapp	Topping Spl	Henry Topping, Jr	Maserati	V8	3.385	4.200	305	OHC	Win	2	BoM	Beld
16	1L	Bill Cummings	Boyle Spl. FD	M. J. Boyle	Offen	4	4.250	4.500	255	OHC	Win	2D	BoM	Pak
17	10P	George Connor	Marks Miller Spl	Joe Marks	Miller	4	4.250	4.625	262	OHC	Win	2U	BoM	Pak
22	89L	Joe Thorne	Thorne Spl. FD	Joe Thorne	Offen	4	4.078	4.250	222	OHC	Win	2U	BoM	Beld
23	NE	Ronnie Householder	Topping Spl	H. J. Topping	Miller	4	4.0625	4.500	233	OHC	Win	2U	BoM	Beld
24	NE	Frank Brisko	Elgin Piston Pin Spl	Frank Brisko	Brisko	6	4.1250	4.375	350	OHC	....	....	....	....
25	3P	Kelly Petillo	Petillo Spl	Kelly Petillo	Offen	4	4.500	5.00	318	OHC	Win	2	BoM	Pak
26	4P	Frank Wearne	Four Wheel Dr. Spl	Peter de Paolo	Miller	4	4.250	4.500	255	OHC	Win	2U	BoM	Pak
28	NE	Bill Devore	Miller Spl	H. E. Winn	Miller	4	4.250	4.500	255	OHC	....	2U	BoM	Pak
31	38L	Chet Gardner	Burd Piston Ring Spl	Chet Gardner	Offen	4	4.250	4.500	255	OHC	Win	2	BoM	Pak
32	...	Floyd Davis	Thorne Spl	Joe Thorne	Miller	4	4.250	4.500	255	OHC	....	2U	BoM	Pak
33	192L	Bob Swanson	Fink Auto Spl	Paul Weirick	Offen	4	4.250	4.750	269	OHC	Win	2U	BoM	Pak
34	196L	Shorty Cantlon	Bowes Seal Fast Spl	Bill White, Inc	Miller	4	4.140	4.250	234	OHC	Win	2D	BoM	Pak
35	108L	Deacon Litz	Motorola Spl	Deacon Litz	Miller	4	4.112	4.250	225	OHC	Win	2	BoM	Pak
36	...	Phil. (Red) Shafer	Shafer "8" Spl	Phil Shafer	Buick	8	3.250	3.875	256	Rocker Arms	Win	4D	Delco	Pak
37	...	Duke Nalon	Elgin Piston Pin Spl	Nowak Magnee	Stude	8	3.062	4.250	250	L hd	Win	4U	BoM	Pak
38	183L	Tony Gulatto	Burd Piston Ring Spl	Joe Lencki	Offen	4	4.250	4.500	255	OHC	Win	2U	BoM	Pak
39	21L	Frank McGurk	Belanger Miller Spl	M. Belanger	Miller	8	3.3125	3.750	258	OHC	Miller	4D	BoM	Pak
41	NE	Ken. Fowler	Lucky Teetor Spl	Lucky Teetor	McDowell	4	4.0625	4.500	233	OHC	....	....	....	....
42	21L	Al Miller	Thorne Spl	Joe Thorne	Miller	4	4.250	4.500	255	OHC	Miller	2U	BoM	....
43	38L	Dave Evans	Duray-Sims Spl	Duray-Sims	Miller	4	4.102	4.250	220	OHC	Win	2	BoM	Pak
44	116L	Tony Willman	Duray Spl	Mrs. Leon Duray	Miller	4	4.102	4.250	220	OHC	Win	2	BoM	Pak
45	11P	Cliff Bergere	Midwest Red Lion Spl	G. H. Lyons	Offen	4	4.250	4.500	255	OHC	Win	2D	BoM	Pak
46	NE	Al Putnam	Shafer "8" Spl	Phil Shafer	Buick	8	3.181	4.625	294	Rocker Arms	Win	4D	Delco Bat	Pak
47	NE	Harry McQuinn	Sullivan O'Brien	Tom O'Brien	Miller	4	4.0625	4.750	247	OHC	Win	2D	BoM	Pak
48	17	Emil Andres	Carew Spl	S. Stewart Carew	Cragar	4	4.000	4.250	215	OHC	Win	2D	BoM	Pak
49	NE	Henry Banks	Kimmel Spl	Louis Kimmel	Voelker	V12	$3\frac{1}{16}$	3.750	332	OHC	Zenith	3D	BoM	Pak
51	NE	Johnny Seymour	Stewart Spl	Wm. Stewart	Stewart	4	4.3125	4.375	256	OHC	Win	2U	BoM	Pak
52	9P	Zeke Meyer	Thorne Spl. FD	Joe Thorne	Stude	8	3.062	4.250	250	L hd	Win	4D	BoM	Pak
53	NE	Louie Tomei	Sabonite Spl	D. H. Sanders	Stude	8	3.500	4.375	336	L hd	Strom	4D	BoM	Pak
54	NE	Herb. Ardinger	Chicago Rawhide Oil Seal Spl	Louis Welch	Miller	4	4.250	4.500	255	OHC	Win	1	BoM	Pak
57	NE	Geo. Bailey	"Lafayette, Ind." Spl	Souders Galivan	Dues	8	2.947	5.000	263	OHC	....	....	....	....
58	NE	Louis Webb	Superior Trailer Spl	Race Car Corp	Miller	4	4.062	4.750	246	OHC	Win	2D	BoM	Pak
59	NE	Doc Williams	Superior T. Spl	Race Car Corp	Own	V8	3.0625	3.750	221	L hd	....	....	....	....
61	NE	Ray Yaeger	Yaeger Spl	Raymond Yaeger	Stude	8	3.0625	4.250	250	L hd	Win	4D	Scint	Pak
62	6P	Floyd Roberts	Thorne Spl	Joe Thorne	Miller	4	4.250	4.750	269	OHC	Win	2U	BoM	Pak
63	NE	Thos. Cosman	Wehr 2 Gl. Rot. V. Spl	Rudy Wehr	Wehr	4	4.000	4.250	213	Rot. V.	Win	1D	BoM	Pak
72	NE	Lee Oldfield	Oldfield Spl	Lee Oldfield	Marmon	V16	2.697	4.000	365	Rocker	Strom	1 Horz	BoM	Pak
..	...	Milt Marion	Crystal Flash Spl	Milt Marion	Miller	4	4.125	4.500	238	OHC	Win	2D	BoM	Pak

ABBREVIATIONS:
P—Finish position
L—Lap out
NE—Not entered
OHC—Overhead camshaft

Win—Winfield
Strom—Stromberg
U—Updraft
D—Downdraft
BoM—Bosch Magneto

Scint—Scintilla
Pak—Packard
Beld—Belden
Cham—Champion
Bow—Bowes

Bo—Bosch
DE—Delco
HC—Hand Crank
Spr—Springs i. e. Hotchkiss
T.T.—Torque Tube

formed by the feed line just before it was attached to the gear case.

The weight of the cars is being kept down to the minimum as far as possible. The lightest weight car according to the records is that of Floyd Davis, exceeding the minimum limit by only 12 pounds. The heaviest is that of Tomei weighing 690 pounds more. The average of 37 cars already weighed is 1971 pounds.

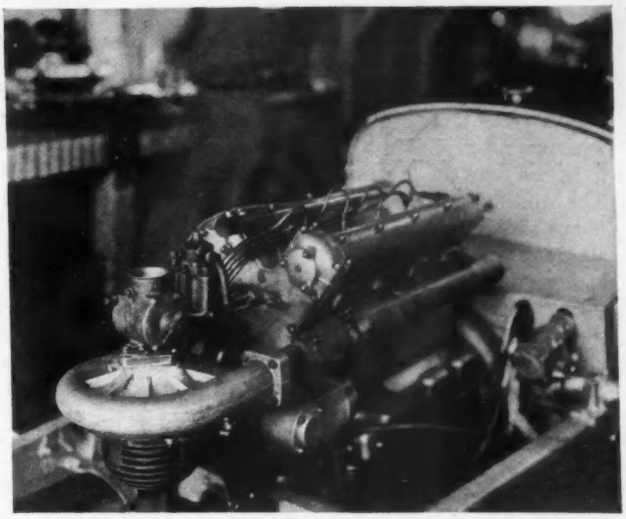
Since tires are a big problem this year it is very noticeable that bigger tires are being used on the driving wheels. This is particularly noticeable on the Maserati that "Babe" Stapp is driving and on the Sparks Special, that Jimmy Snyder has broken all track records with.

At the speeds these cars make on the turns this year bearing loads are higher than ever. Practically every American built car carries New Departure bearings in its wheels as well as in other parts.

Some of the technical features of the cars are best grasped if we analyze the tabular information. Out of 50 entries 41 have rear-wheel drive, one four-wheel drive and eight with tractive wheels in front. The torque tube drive is also most common, 60 per cent having it and of the remainder 30 per cent have front-wheel drive in which the torque is taken through pairs of quarter elliptic springs.

Brakes are divided between hydraulic and mechanical operation. Twenty-four are hydraulic and 21 are mechanical. The rest are unspecified.

Spring suspensions are interesting this year particularly because two of the cars have introduced the torsion bar type of spring for the first time at the Speedway. The Maserati has two torsion bars at the front and semi-elliptic at the rear although the rear suspension is independent for each wheel. The front suspension on this car is by parallel links from the frame to each wheel. The top link has the torsion bar attached to it at the frame end and the bar extends rearward to the dash. There it is clamped to



Schwitzer Cummings supercharger on front of Duray motor

The Other Details

Spark Plug Make	Starter Make	Super Charger Make and Type	Type Drive	Drive Reaction	Brakes Type F	Brakes Type R	Shocks Front Make No.	Shocks Rear Make No	Springs Front	Springs Rear	Tire Size Front	Tire Size Rear	Body Width Inches	Car Weight Pounds	Fuel To Be Used	Oil To Be Used	Car No.
Cha	Bo	None	R.D.	T.T.	H	H	Ga	Ho-Ha	½E	½E	5.50x18	7.00x18	31	1875	Gilmore	Gilmore	1
Cha	Bo	None	R.D.	T.T.	M	4	Ho-Ha	Ho-Ha	½E	T	6.00x18	7.50x18	31½	2156	Gulf	Oilzum	2
Cha	HC	Cent.	F.D.	Spr	M	4	Ha	Ha	¼E	½E	6.00x20	6.00x20	31	1850	Gulf	Castor	3
Cha	HC	Cent.	R.D.	T.T.	H	H	Ho-Ha	Ho-Ha	½E	T	6.00x18	7.50x18	31	1993	Gilmore	Gilmore	5
Cha	Bo	None	R.D.	T.T.	H	H	Ga	Ga	½E	T	6.00x18	7.00x18	33	1834	Gilmore	Gilmore	6
Cha	HC	None	F.D.	Spr	M	M	Ha	Ha-Ga	¼E	½E	6.50x18	6.50x18	31½	1827	Gulf	Oilzum	7
Cha	Bo	None	R.D.	T.T.	M	M	Ha-Ga	Ha-Ga	½E	½E	6.00x18	7.00x18	31½	1889	Gilmore	Gilcast	8
Cha	Bo	None	R.D.	T.T.	H	H	Ha-Ga	Ha-Ga	½E	½E	6.00x18	7.00x18	31	1867	Gulf	Gulf Pride	10
Cha	....	Cent.	F.D.	Spr	M	M	2 Ha	2 Ha	¼E	½E	6.00x20	6.00x20	33	2009	Gilmore	Gulf	12
Bow	HC	2 Roots	R.D.	....	H	H	Fh	Fh	I.S.	I.S.	5.50x18	6.50x19	32	1831	Gilmore	Gilmore	14
....	....	....	R.D.	....	H	H	Ha	Ha	T.B. (I.S.)	½E	5.50x18	7.00x16	31	1935	Gilmore	Gilmore	15
Cha	DE	None	F.D.	Spr	M	M	Ha	Ha	¼E	½E	6.50x18	6.50x18	31	1932	Gulf	Oilzum	16
Cha	Bo	None	R.D.	T.T.	M	M	Ha-Fa	Ha-Fa	½E	T	6.00x18	7.00x18	31	1862	Gilmore	Gilmore	17
Cha	Bo	None	F.D.	Spr	H	H	Ga	Ga	¼E	½E	7.00x18	7.00x18	31	....	Gilmore	Gilcast	22
Bow	DE	None	R.D.	....	H	H	Ho	Ho	¼E	½E	5.50x18	7.00x18	31	1828	Gilmore	Gilmore	23
....	....	....	F.D.	Spr	H	H	Ha-Fa	Ha-Fa	¼E	½E	7.00x18	7.00x18	..	....	Gulf	Gulf	24
Cha	Bo	....	R.D.	T.T.	M	M	Ga	Ga	½E	½E	6.00x18	7.50x18	31	....	Gulf	Oilzum	25
Cha	Bo	None	4 WD	Spr	M	M	Ha-Fa	Ha-Fa	¼E	¼E	7.00x18	7.00x18	32	2315	Gilmore	Gilmore	26
Cha	Bo	None	R.D.	T.T.	H	H	Ha	Ha	½E	½E	6.00x18	7.00x18	31	....	Gulf	Gulf	28
Cha	Bo	None	R.D.	T.T.	H	H	Ha-Ga	Ha-Ga	½E	½E	6.00x18	7.00x18	32	1958	Gulf	Gulf	31
Cha	DE	None	R.D.	T.T.	H	H	An	An	....	....	6.00x18	7.00x18	32	1812	Gilmore	Gilcast	32
Cha	Bo	None	R.D.	T.T.	H	H	Ha-Ho	Ha-Ho	½E	T	6.00x18	7.00x18	31	1935	Gilmore	Gilmore	33
....	Bo	None	R.D.	T.T.	M	M	Ga	Ga	½E	½E	5.50x18	7.00x18	32	1818	Gilmore	Gilmore	34
Cha	Bo	None	R.D.	T.T.	H	H	Ga-Ha	Ga-Ha	½E	½E	6.00x18	7.00x18	31	1914	Gilmore	Gilmore	35
Cha	DE	None	R.D.	T.T.	M	M	2 Ho	2 Ho	½E	½E	......	......	38	....	Gulf	Gulf	36
Cha	DE	None	R.D.	Spr	H	H	Ho	Ho	....	....	6.00x18	......	31	1846	Gilmore	Gilmore	37
Cha	Bo	None	R.D.	T.T.	H	M	Ha	Ha	½E	½E	6.00x18	7.00x18	33	1922	Gilmore	Gilmore	38
Cha	Bo	None	R.D.	T.T.	M	M	2 Ha	4 Ha	½E	½E	6.00x18	7.00x18	31	1962	Gilmore	Gilcast	39
....	....	....	R.D.	T.T.	H	H	....	....	½E	½E	6.00x18	7.00x18	..	1896	Gulf	Gulf	41
Cha	DE	None	R.D.	T.T.	H	H	Sc	Sc	½E	½E	6.00x18	7.00x18	33	1820	Gilmore	Gilmore	42
Cha	Bo	None	R.D.	T.T.	H	H	Lo	Lo	½E	½E	6.00x18	7.00x18	33	1870	Gilmore	Gilcast	43
Cha	Bo	None	R.D.	T.T.	M	M	Lo	Lo	½E	½E	6.00x18	7.00x18	36	1855	Gilmore	Gilcast	44
Cha	DE	None	R.D.	T.T.	H	H	Ho-Ha	Ho-Ha	½E	½E	6.00x20	7.00x18	31	2040	Gilmore	Gilmore	45
....	....	....	R.D.	T.T.	M	M	Ga	Ga	½E	½E	......	......	37	2296	Gulf	Gulf	46
Cha	DE	Cent.	R.D.	T.T.	H	H	Lo	Lo	½E	½E	5.50x18	7.00x18	31	1980	Gilmore	Gilmore	47
Cha	Bo	None	R.D.	T.T.	H	H	Ho	Ho	½E	T	6.00x18	7.00x18	34	2019	Gulf	Gulfcast	48
Cha	Bo	None	R.D.	T.T.	H	H	....	....	½E	½E	6.00x18	7.50x18	..	....	Tydol	Veedol	49
Cha	Bo	....	R.D.	T.T.	H	H	Lo	Lo	½E	½E	6.00x20	6.00x20	33	2140	Gilmore	Gilcast	51
Cha	DE	None	F.D.	Spr	M	M	Ga	Ga	¼E	½E	6.00x20	6.00x20	33	2086	Gilmore	Gilmore	52
Cha	DE	None	R.D.	Spr	M	M	Ho	Ho	½E	½E	7.00x18	7.00x18	34	2490	Gilmore	Gilmore	53
Cha	Bo	Cent.	R.D.	T.T.	M	M	Ho	Ho	T	T	6.00x18	6.50x18	34	2169	Gilmore	Gilmore	54
....	....	....	R.D.	T.T.	..	..	....	....	....	....	......	......	..	....	Gulf	Gulf	57
Cha	DE	None	F.D.	Spr	M	M	Ha	Ha	¼E	½E	6.00x20	6.00x20	32	....	Gilmore	Gilmore	58
....	....	....	....	....	..	..	....	....	....	....	......	......	..	....	Gulf	Gulf	59
Cha	DE	None	R.D.	T.T.	H	H	Ho	Ho	½E	½E	......	......	32	2119	Gulf	Gulf	61
Cha	Bo	None	R.D.	T.T.	M	M	Fa-Ha	Fa-Ha	¼E	¼E	6.00x18	7.50x18	31	1954	Gilmore	Gilcast	62
Cha	Bo	Cent.	R.D.	Spr	M	M	Lo	Lo	½E	½E	......	......	36	1986	Gilmore	Gilmore	63
Cha	HC	Vane	R.D.	R.R.	H	H	Lo	Lo	C(I.S.)	TB(I.S.)	6.00x16	7.00x16	..	....	Gilmore	Gilmore	72
Cha	Bo	None	R.D.	T.T.	H	H	Ha	Ha	½E	½E	6.00x18	7.00x18	32	....	Super Flash	Crystal	..

R.R.—Radius Rods
Ga—Gabriel
Ho—Houdaille
Ha—Hartford
Fa—Fageol

Lo—Lovejoy
An—Andre
Fh—Special Friction Hydraulic
Sc—Sciata
½E—Semi Elliptic

¼E—Quarter Elliptic (usually 2 are used, one above the other)
I.S.—Independent where Suspension
C—Coil Spring
TB—Torsion Bar Spring

Corrected to May 24, 1937.

the top of the frame rail. The steering gear is connected to the front wheels by independent drag links on each side of the frame. A transverse shaft connects each steering arm to the steering gear. These drag links are not attached to the steering knuckle arm with a ball-and-socket joint but by a universally jointed link with through bolts.

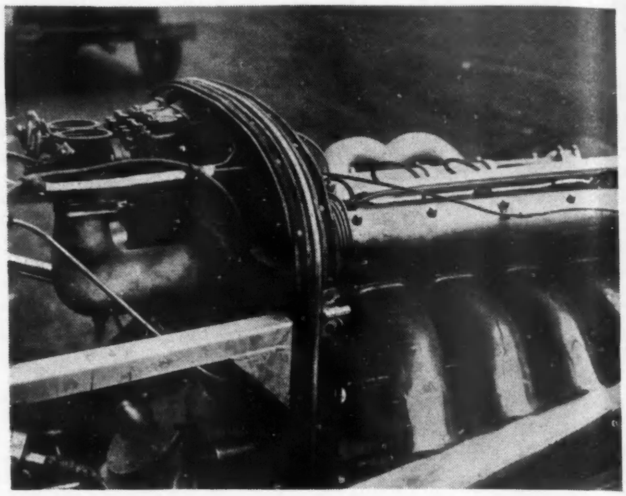
In the rear the Maserati suspension is equally interesting. The wheels are carried on swinging axle tubes which pivot about the differential housing in ball-and-socket joints. The single universal joint used to drive each rear wheel is located at the center of this ball joint. The springs are semi-elliptic and shackled front and rear to brackets on the outside of the frame. The shackles have a universal mounting so that they put no strain on the spring leaves. To take the brake and drive torque reactions on each of these rear wheel axle housings, two short arms are welded to the housing, just outside the car frame. Their center line is vertical and coincides with the center line of the axle. Each arm terminates in a ball. Links with ball sockets at each end connect the frame to the arms. The top arm is connected toward the front to a frame bracket and the lower arm to a bracket to the rear. Thus these members are under tension in normal operation.

Carburetors are widely varied in their make and design. Winfield has 37, Miller four, Stromberg two and Zenith one. Thirty-one are of the dual type, five are single and eight cars have four carburetors each. The downdraft carburetor is only a bit ahead of the updraft, the first is found on 18 engines and the latter on 15. There are also two horizontal jobs. Eleven have not finally decided.

Bosch magneto ignition is found on all cars except three that have battery ignition. Packard Cable have 42 and Belden three cars equipped with their wires. Champion Spark Plugs are found on 42 of the entrants and only two so far have indicated their intention to use any other plug. Louis Vollmar of the United American Bosch Corp., is one of the authorities on ignition. He has two new types of magnetos to meet the particular conditions met on this year's engines. There is a new GE-16 for the V-16 engine giving eight sparks per revolution. This is twice the number usually obtained from this type of magneto. It is the inductor type. For the 6-cylinder cars this year their new JO-6 type of magneto is used. This gives four sparks per revolution so that it has to be geared three-quarter engine speed. A three-lobed cam is used and double breakers to give the proper timing. The wiring on this unit is completely shielded as it is very light and developed originally for aircraft use. Oil insulated condensers are used in the primary on these new magnetos and the secondary condenser is built right into the winding.

Earl Twining of the Champion Spark Plug Co. is field engineer in charge of the ignition installations here at the track. He is accompanied this year by Bob Strannahan, Jr., who is following in his father's footsteps. With super-compressions last year there were many spark plug problems. This year they say it is possible to use standard plugs. The R-1 seems to be the principle plug that meets the standard fuel conditions. Where a colder plug is necessary the R-11 can be used. The evidence seems to point to the fact that with 83 octane fuel these engines deliver as much or more horsepower than they did last year and they don't have to pull the spark back far enough to kill acceleration.

In regard to spark plugs it may be of interest to note the fact that most of the dual camshaft overhead valve engines have the plug located in the top center of the combusion chamber. This is true whether the engine has two or four valves per cylinder. The thing which few people know is that the plug is not screwed into the cylinder but into a steel sleeve which is pressed into the top of the cylinder



McQuinn motor showing supercharger and carburetor mounting. Second fastest record lap holder 127 m.p.h.

head and not fastened to the water jacket wall. The joint at this point is closed by a rubber gasket. This provides a close contact between the cooling water around the sleeve and the end of the plug which is screwed into the cylinder. Then to protect the spark plug points it is not directly exposed to the gases in the combustion chamber but is shielded from them. There is a small hole about 5/16 in. in diameter opening from the combustion chamber into the spark plug pocket.

Practically all of the cars have Ray-Day aluminum alloy pistons. Some interesting pistons have been developed during the past year to get the lower compressions without changing the cylinder design. On some of these the cup shape of the top looks as though it was from a Knight engine. In fact some of them are so low that the underside might strike the top of the connecting rod unless that is properly machined off.

Aluminum engines are found on the Kimmel V-12 and the Brisko six. Floating steel sleeves in the former are fully water cooled. The heads are detachable so that the sleeve can be seated against a copper gasket in the cylinder can clamped down by the head. The lower end is packed by a rubber gasket just like the spark plug sleeves.

The Maserati engine is unique in one respect from all of the other engines here. The cylinders are cast in pairs instead of in blocks. They are mounted on a magnesium alloy crankcase at the bottom and tied together at the top by the camshaft housing which runs the length of the engine. There are but two camshafts on this engine as the cylinders are evidently small enough to get their maximum power through two instead of four valves. The valves are therefore in line with the camshaft. The spark plugs on this engine are on the inside of the "Vee" and on the side of the combustion chamber.

As I close this story the reason why qualification trials of several fast cars has been delayed is due to the contest rules. Several of the cars that can lap at 120 or better have superchargers and the drivers are not sure, even now, that they want to run 500 miles with them. If they qualify with a blower, they have to run in the race with it. As this is written three cars with blowers may try to qualify without their superchargers. This, of course, will change their performance but perhaps the drivers think it will increase their reliability so as to make them sure of finishing in the money.

Cast Iron Gets Talked About

Although most of the old engineering handbooks refer to cast iron as a low strength material having a tensile strength around 15,000 lb. per sq. in., R. S. MacPherran, chemist, Allis-Chalmers Mfg. Co., in his recent AFA paper, entitled "Cupola High Test Cast Iron," drew the attention of engineers to the fact that modern cast irons are high grade, high test materials possessing a tensile strength exceeding 50,000 lb. per sq. in.

Typical analyses of the material used by Allis-Chalmers, together with stress-strain curves, are found in Fig. 1. The fatigue value of high test cast iron is about one-half the tensile strength. It is quite sensitive to heat treatment and may be easily hardened by quenching in oil, even for fairly complicated castings. The hardness thus produced is equal to that of chilled iron.

Machinability is an important factor and alloys may be added to improve this characteristic. For this reason, although high test irons can be produced with or without the addition of alloys, improvements in machinability and fineness of grain may be achieved by the addition of ½ to 1 per cent nickel. "Or he may use copper for somewhat the same purpose. In former years copper was thought to make iron red short. We have now made many tests at temperatures up to 1200° F. of irons containing 1 per cent copper and found no greater loss of strength than usual in other irons."

"Assume, for example, that an iron without alloys gives a tensile strength of 50,000 lb. per sq. in., adding 1 per cent nickel will usually bring this to 55,000; adding 0.30 molybdenum with the nickel should increase this to nearly 60,000 lbs., with a better impact value, and increasing the molybdenum to 0.5 will raise it still further. If additional hardness is desired, powdered ferrochromium may be added in the spout. In considering any additions, however, one should bear in mind the increased cost."

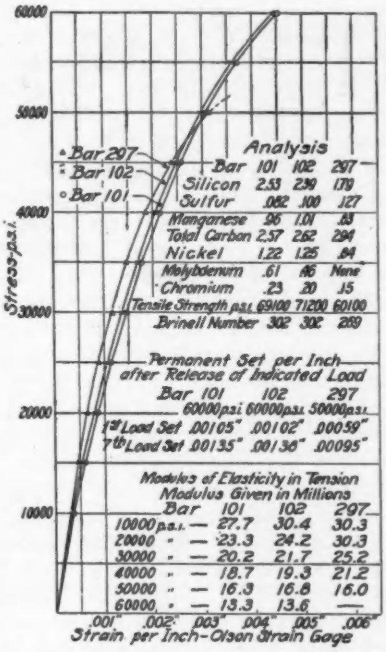
"We have made in the 'as cast' condition, tests of over 86,000 lbs. per sq. in.; but we would not, of course, guarantee such strength in castings."

"Cast Iron Suitable for Nitrogen Hardening" was the subject presented by J. E. Hurst, technical director, Sheepbridge Stokes Centrifugal Castings Co., Ltd., of England at the recent meeting of the American Foundrymen's Assn. in Milwaukee.

The alloy cast irons suitable for nitrogen hardening which have come to be known as "Nitricastiron" are essentially alloy cast irons containing aluminum and chromium. In this respect they are analogous to the aluminum chromium series of alloy steels introduced for this purpose and known as Nitralloy Steels. Typical analyses and mechanical test results have been described by the author, and are summarized in a convenient form in Table 1.

Many different types of castings in this material have been produced already, both by centrifugal casting and ordinary sand casting methods, but by far the largest commercial application at the present time is the production of cylinder liners. Large numbers of Nitricastiron liners have been fitted to various types of gasoline, oil and compression ignition engines and many of these have been in service for considerable periods. Full details of the determination of the resistance to wear of Nitricastiron cylinders under actual engine running conditions have been published by the writer in a paper before the Iron & Steel Institute (England).

The development program has been attended by a great amount of road testing to determine the life of super-hard liners. All tests were carried out for periods of 10,000 miles or multiples, and the resistance to wear expressed in terms of miles per one-thousandth of an inch wear. A strict comparison of the results obtained can be made only on the basis of equal mileages. At a mileage of 30,000, the resistance to wear of nitrogen hardened alloy cast iron compared with ordinary cast iron as used normally for cylinder liners was as 2:1 and compared with chromium alloy cast iron as 2.6:1. At a mileage of 40,000 the ratio of nitrogen hardened to chromium alloy cast iron still remained the same as 2.6:1. These results refer to tests carried out in a stationary engine.



Stress-strain diagram of high test cast iron

In actual road tests, while the wear value in miles per 0.001 in. of wear was smaller in magnitude, at a mileage of 40,000 the ratio of nitrogen hardened to the hardened and tempered chromium alloy was found to be as 2.2:1, a figure in close agreement with the stationary engine tests. In the actual wear values the nitrogen hardened cast iron showed results of from 10,000 to 32,000 miles engine running for a wear of 0.001 in. cylinder diameter. A matter of some interest was the fact that the differences between the wear values of ordinary cast iron, alloy cast irons in the "as cast" condition, and hardened and tempered cast irons were not very large.

In conclusion, the author presents the following general details of preparatory production techniques in handling Nitricastiron parts:

(1) Rough machine to remove bulk of the material leaving ample allowance on all surfaces to accommodate any distortion which may occur during the stabilizing treatment. Good radii should be left everywhere and all corners should be well rounded. It is advisable to retain as much bulk of material as possible on surfaces not required to be hardened until after the hardening operation in order that the parts shall be as rigid as possible during the hardening treatment.

(2) Stabilize by heating to a temperature of 1022° Fahr. to 1112° Fahr. (550° C. to 600° C.) for a period of from ½ to 6 hours according to size and complexity of the casting. This treatment can be followed by cooling freely in still air. The purpose of this

(*Turn to page 823, please*)

Table 1

Comparison of Properties of Centrifugally Cast and Sand Cast Nitrogen Hardening Cast Iron

	Centrifugal Per Cent	Sand Cast Per Cent
Analysis		
Total Carbon	2.65	2.62
Graphite	1.10	1.63
Combined Carbon	1.55	0.99
Silicon	2.58	2.44
Manganese	0.61	0.60
Sulphur	0.07	0.075
Phosphorus	0.096	0.098
Chromium	1.69	1.58
Aluminum	1.43	1.37
Modulus of Elasticity	lb. per sq. in.	lb. per sq. in.
As Cast	22,500,000	19,500,000
Annealed	23,700,000	19,700,000
Hardened and Stabilized	23,000,000	19,200,000
Nitrogent hardened	23,500,000	20,100,000
Tensile Strength	lb. per sq. in.	lb. per sq. in.
As Cast	55,000	44,350
Annealed	66,750	51,300
Hardened and Stabilized	66,100	64,100
Nitrogen hardened	66,750	53,500
Permanent Set	Per Cent	Per Cent
As Cast	2.5	6.1
Nitrogen hardened	4.75	9.7
Firth Diamond Hardness	No.	No.
As Cast	418	340
Annealed	302	269
Hardened and Stabilized	302	300
Nitrogen hardened	982	904

Automatic Transmission In

HEREWITH are shown a number of sectional assembly drawings of the new Oldsmobile automatic transmission announced in AUTOMOTIVE INDUSTRIES of May 22. As may be seen from the longitudinal vertical section, Fig. 1, the transmission comprises three distinct gear trains—a conventional sliding gear assembly at the left (the forward end in the car), which determines whether the motion of the car is to be forward or reverse; in the center, a single-reduction planetary assembly referred to as the forward planetary unit, and at the right, a similar, double-reduction planetary assembly, the rear planetary unit.

Four forward speeds may be obtained by means of this transmission, in addition to a reverse speed. The highest speed is a direct drive, the clutch shaft and intermediary shaft then being coupled together and both of the planetary units locked so that they revolve as solid masses. For the next-to-the-highest (third) speed, the forward planetary unit serves as a reduction gear, giving a reduction ratio of 1.42:1, the rear reduction gear revolving as a unit and transmitting the power directly. For second speed the rear planetary unit serves as a reduction gear, giving a reduction ratio of 2.23, while the forward planetary unit revolves as a unit. For first speed, both of the planetary units act as reduction gears and then give a combined reduction ratio of 3.17:1.

All of the mechanism of the transmission is enclosed in a single housing, which is secured to the flywheel housing in the usual manner. The planetary units are controlled hydraulically by means of a system comprising a double gear pump that delivers oil for both the pressure lubrication of the working parts of the transmission and for the automatic control units or servos.

Referring to Fig. 1, the clutch shaft *A* carries a spur gear *B* which is bell-shaped and provided with internal gear teeth which enable it to act as one member of a direct-drive clutch, the co-acting clutch members being the teeth of the sliding pinion *C* on the intermediary shaft *D*. Below the intermediary shaft (and somewhat over to one side) there is a countershaft or, rather, a stationary arbor, on which is mounted a cluster gear *E* forming part of the reversing gear. Mounted on this cluster gear is a worm *F* through which the oil pump of the control system is driven. In the drawing the sliding pinion is shown in the neutral position; by sliding it toward the left, the clutch members of *B* and *C* engage and the transmission is in position for forward drive, while by sliding it to the right, pinion *C* is brought into mesh with an intermediary gear not shown in the drawing, which also meshes with one of the gears of cluster *E*, and the transmission is set for reverse motion.

Intermediary shaft *D* has the driving gear *G* of the forward planetary unit formed integral with it. Gear *G* meshes with three planetary pinions mounted on carrier *H*, which is splined to the second intermediary shaft *M*, and the planetary pinions also mesh with the sun pinion *I*,

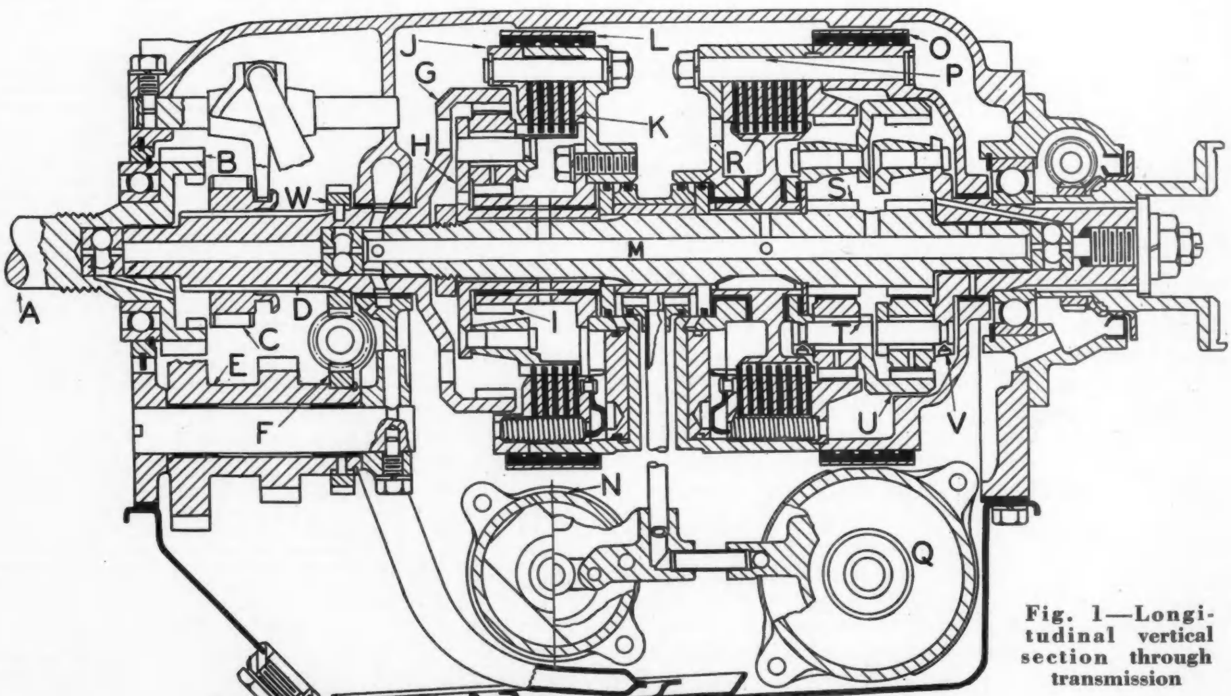


Fig. 1—Longitudinal vertical section through transmission

Olds Has Hydraulic Control

The Whole Story

SINCE the purchase of the patent on which the new Oldsmobile Automatic transmission is based, five years of engineering development, about $1,500,000, and more than 100,000 miles of road and proving-ground testing have been expended on it by Oldsmobile engineers.

It is unlikely, in our opinion, that a device on which so much time and money have been spent will be long allowed to remain an "option" on anybody's line of cars. Because of its potential significance as standard equipment, the Olds automatic transmission assumes additional importance and is described herewith in considerable engineering detail.

For more (non-technical) detail on what the transmission does, we refer you to page 754 of last week's issue of AUTOMOTIVE INDUSTRIES. This is the (rather technical) story of how the transmission works, from the inside out.

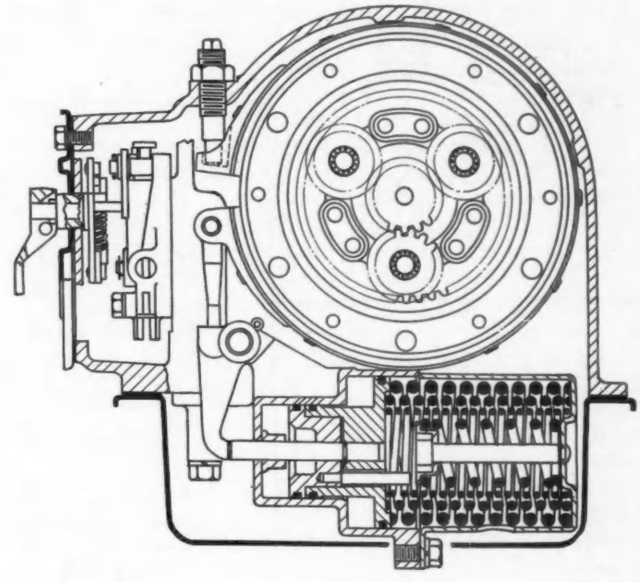


Fig. 3—Side view of rear planetary unit with control cylinder and pressure-control valve

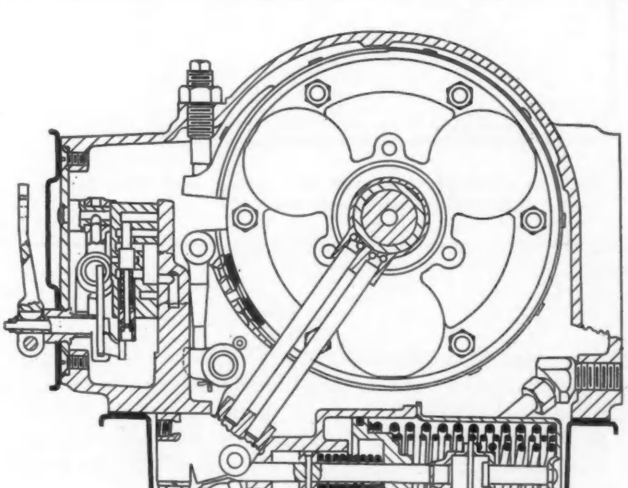


Fig. 2—Side view of forward planetary unit with its control cylinder and oil-pressure-control valve

which has a shaft extension with flange, to which is bolted the drum *J*. The latter may be either held from rotation by means of the friction band *L*, or coupled to the planetary carrier *H* by means of the multiple-disk clutch *K*. When drum *J* is held stationary by the brake band *L*, the front planetary unit serves as a reduction gear, *G* then being the driving, *H* the driven, and *I* the reaction member; on the contrary, when drum *J* is coupled to carrier *H* by the multiple disk clutch *K*, the whole planetary assembly revolves as a unit and transmits the power directly.

Both the brake band *L* and the friction clutch *K* are controlled by means of the hydraulic cylinder *N* located directly below the friction clutch. Within this cylinder there is a piston which is forced in one direction by a number of concentric coiled springs and in the opposite direction by the oil pressure. A piston rod extends from the cylinder and connects to the brake band by means of mechanism that is clearly shown in Fig. 2.

The rear planetary unit, shown at the right in Fig. 1, is similar to the front unit, as regards operating principle, but it comprises two planetary gear trains in series, instead of a single train. The combined reduction ratio of the two trains is 2.23. Thus the torque multiplication due to the rear unit is greater than that due to the front unit, and this calls for a larger rear-unit servo, *Q*, and a larger clutch, *R*. The latter is composed of eight bronze and seven steel plates, as compared with five bronze and four steel plates in the case of clutch *K* of the front planetary unit. The spring pres-

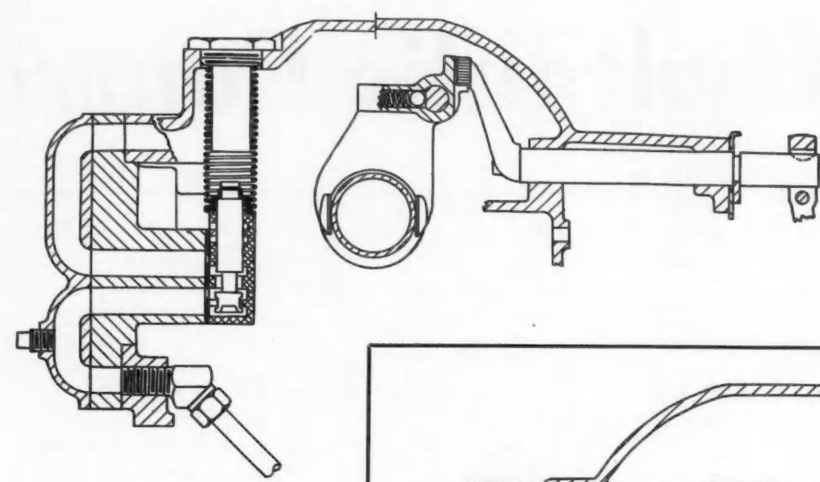


Fig. 5—Detail showing pressure-regulating valve on left and forward-and-reverse shifting mechanism on right

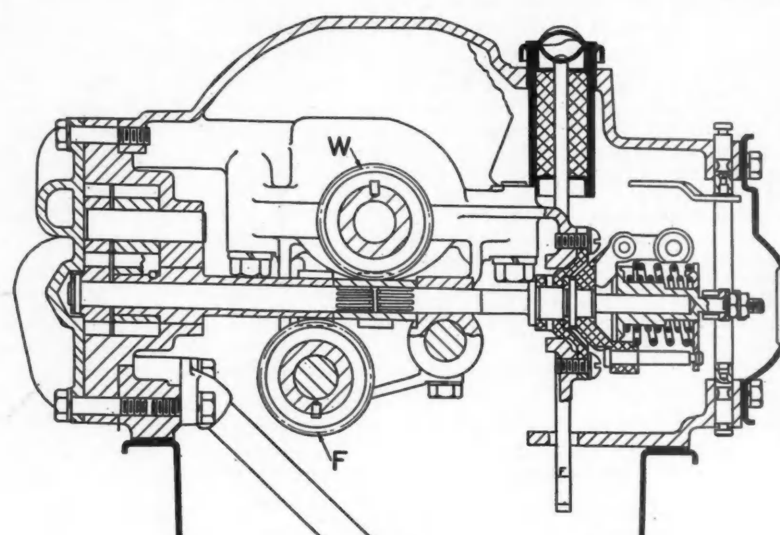


Fig. 4—Section through two-unit oil pump and two-stage governor, with drive therefor

sures of the rear servo unit also are greater. In Fig. 3 is shown a side view of the rear planetary unit, with its control cylinder in section.

With the brake band applied to the drum of the rear planetary unit, pinion *S* is the driving and carrier *T* the driven member of the first-reduction train, while internal gear *U* is the driving and carrier *V* the driven member of the second-reduction train. Carrier *U* is formed integral with the main drive shaft of the transmission, to which one member of the universal joint is splined.

The brake bands of both planetary units are normally applied to their respective drums by the springs of their servos. Consequently, when the control lever is set for low forward speed, whereby the clutch shaft *A* is coupled to the first intermediary shaft *D*, and the main clutch is let in by releasing the clutch pedal, the car starts in "low gear," both of the two planetary units then acting as reduction gears and giving a combined reduction ratio of 3.17. Disengagement of the brakes of the planetary units and engagement of their clutches is effected entirely by oil pressure, which acts on pistons in the servo units and overcomes the force of the springs in these units.

The hydraulic pressure is developed by an oil pump located inside of the transmission. It is a double gear pump, comprising two drive gears of unequal size and two driven gears of unequal size. The larger of the two pump units is driven through worm *F* on cluster gear *E* (Fig. 1) as long as the engine is running and the main clutch engaged, whereas the smaller pump unit, which is driven through worm *W* on the first intermediary shaft, is operating whenever the rear wheels are turning. With the control lever on the steering column in neutral and the engine running, only the large pump is operating, whereas with the control lever in either of the two forward positions and the engine running, both pump units are operating. With the lever in the "reverse" position, both pump units are operating, but in opposite directions; the oil delivery is then dependent on the difference of their capacities, but as under this condition of operation oil is needed only for lubrication, this is entirely adequate.

Fig. 4 is a section through the oil pump and through the centrifugal governor, which latter is driven from an extension of the oil-pump shaft. The pump delivers oil to the pressure regulator valve, of which a sectional view is shown in Fig. 5, and from this valve the oil passes on through branched circuits, one leading to the lubrication passages of the transmission and the other to the control units.

Application of the oil pressure to the servos or control units is under the control of a two-stage flyball governor and of the accelerator pedal (or throttle). A feature of the system is that the governor control is interconnected with the throttle in such a way that the driver may override the governor action at will.

In starting from a standstill, the clutch pedal is depressed, the control lever moved to the "First Forward" position, and the clutch pedal released,

whereupon the car starts in low gear in the usual way. When a speed of 12 m.p.h. has been reached, the governor actuates its valve, with the result that the friction band of the front planetary unit is released and the clutch of this unit engaged. This planetary unit then virtually becomes a coupling and its speed-reducing function is suppressed, which is equivalent to "shifting into second speed." The second gear affords the most favorable accelerating range, and the transmission can be kept in second as long as the driver desires.

Up to this point the transmission has been in the "First Forward" range. To get into the "Second Forward" or driving range, which covers the third and fourth speeds, the operator moves the control lever to the "Second Forward" position, which he does without disengaging the main clutch. With the lever in this position, whether the car is being driven in third or fourth depends on the position of the throttle. If, while driving in third, the driver holds the throttle open only slightly, the shift to fourth occurs automatically at about 23 m.p.h. On the other hand, if the throttle is held wide open (for maximum acceleration) the shift will occur only at 65 m.p.h., while for intermediate throttle positions the shift occurs at speeds somewhere between these two extremes. The relationship between shifting speed and throttle opening is controlled by linkage between the governor and the front-unit valve. Throttle movement modifies the shifting speeds by extending the linkage and causing the governor weights to move farther before tripping the valve.

The distinctive feature of operation in the high range, between third and fourth, now comes into play. As already mentioned, the governor and throttle are interconnected. If while driving in fourth it becomes desirable to increase the throttle opening, to meet a condition of increased driving resistance (as when approaching a grade or when wanting to accelerate to pass another car), the driver will feel a definite resistance to throttle movement for an instant, and as he passes that point he overpowers the governor control and the transmission automatically shifts down to third.

Another feature of the automatic control is that with the car running in fourth, if it becomes necessary to slow down in traffic or coast to a stop, the governor will automatically shift down to third when the road speed drops to around 15 m.p.h.

It is also possible to start the car in the high range from a standstill, by merely depressing the clutch pedal and moving the control lever to the high-forward position. This causes the car to be started in first gear, and a shift to the third gear to be made at about

(Turn to page 823, please)

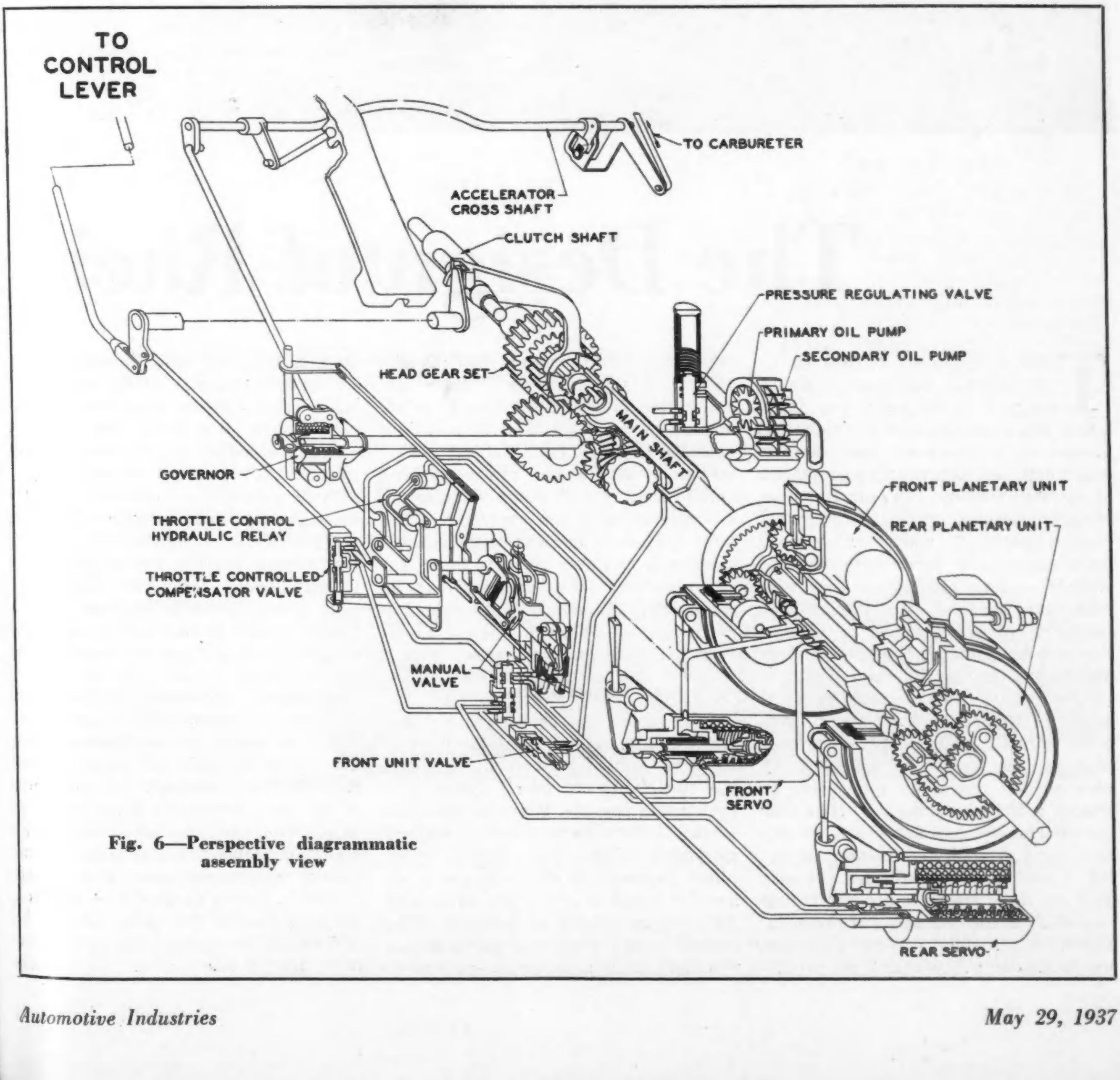
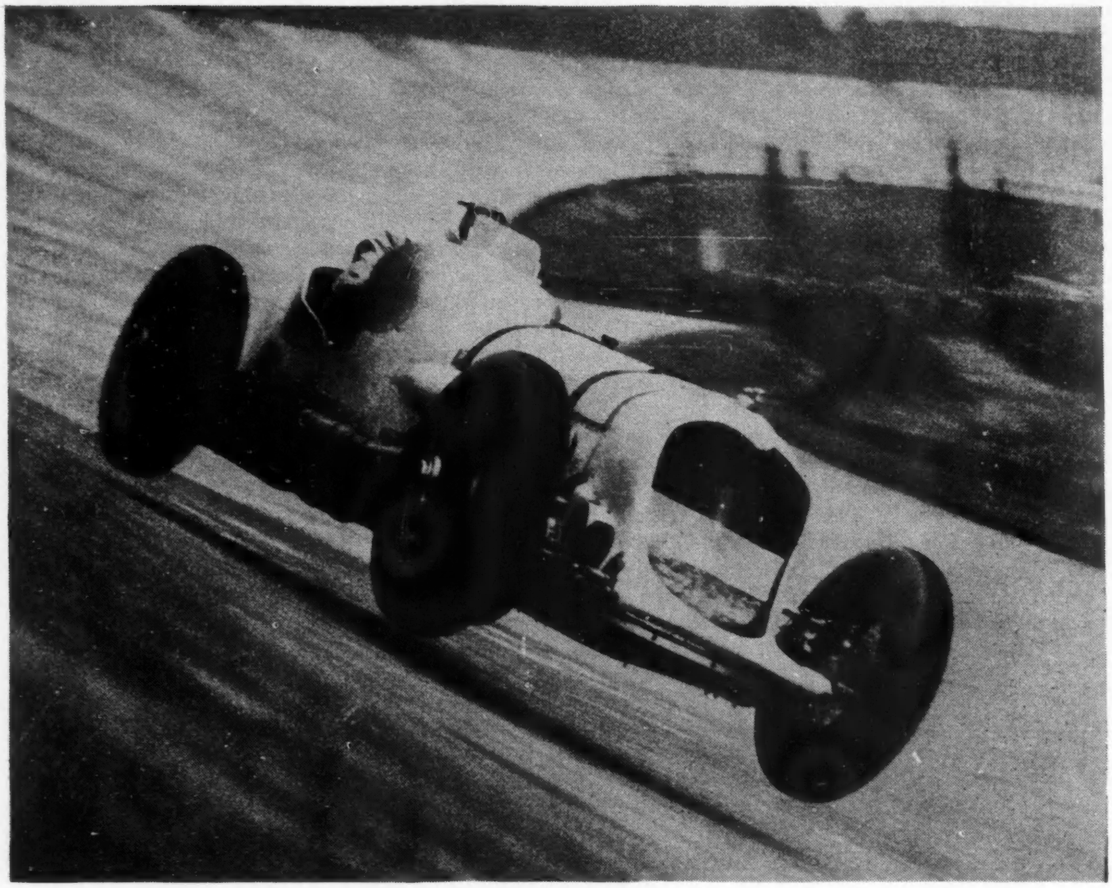


Fig. 6—Perspective diagrammatic assembly view



The Design of Racing Ca

THE development of the racing car today is taking place almost entirely in Germany and Italy. These two countries take the view that success in international road races is well worth the cost, simply as a matter of national prestige. In both countries certain factories receive Government "encouragement," which in various ways amounts to a very considerable subsidy, so long as they perform with reasonable success in the big European races. There is, of course, nothing of this sort in England. Under these conditions, the only possible source of supply for the large sum of money required is the British motor trade itself. Not being directly interested in national prestige, the leaders of the industry have so far shown no inclination to finance a British racing car. It is true that, during the last few years, British cars have figured prominently in the list of world speed records, but the cars used for these attempts are not racing cars at all in the true sense of the term. They are generally vehicles built for one particular purpose, and are useless for competitive racing on road circuits. It may be said in favor of these machines that their exploits have a certain amount of "prestige value." Those well qualified to judge, consider that the retention by England of the world land speed record is well worth while so far as overseas sales are concerned. The author, so far as modern racing cars are concerned, can only claim to be an expert observer. Of world record cars he can speak with more confidence, having been engaged in their design and manufacture for the last six years.

Springing

In a racing car the suspension system has as its chief object the maintenance of contact between the tire and the road, with as nearly constant a pressure as possible. Whenever the road surface is such as to impart a vertical movement to the road wheels, it becomes necessary to devise means to allow the wheel to follow the surface of the road as closely as possible. The inertia of the unsprung parts, acting vertically, tends to cause excessive pressure at the start of a bump, followed by reduced pressure at the top of the bump; and it is this reduction of pressure which, by reducing the adhesion, has a bad effect on the road-holding qualities of the car. Actually, it is difficult enough to prevent this pressure dropping frequently to zero under racing conditions; in other words, to stop the wheels leaving the ground altogether. Clearly, then, the most important single factor is to keep the unsprung weight to an absolute minimum, and this is in fact one of the chief aims of the designer.

Considering the nature of the link between the axle and the frame of the car, it is nearly useless to attempt an analysis of the action of the spring and damping mechanism, which, in one form or another, invariably form this link on a racing car. The interaction of the kinetic energies of the sprung and unsprung weights are directly dependent on such variables as the size of the tires, the air pressure, the wheel centers, the stiffness of the springs, the spring centers, the disposition of the chassis

weight, the torsional stiffness of the frame, its stiffness as a beam, the nature of the road surface, etc. However, one or two guiding principles do emerge: (1) The greater the ratio between the sprung and the unsprung weights the better, for obvious reasons; (2) the greater this ratio, the more flexible the springs that will give the optimum condition of safety; (3) the greater this optimum flexibility, the worse the surface that can be traversed with safety; (4) the worse the surface, and the greater the amplitude of vertical movement, the more absorption of energy must be allowed for in the damping mechanism.

From this it is clear that the nature of the road upon which the car is expected to run should have a big influence on the design of the suspension. This is in fact true, but it is only too often overlooked. About the worst surface that a racing car ever has to face is the track at Brooklands. Owing to the gradual sinking of the foundations, its surface is rich in wave-like formations, which at high speeds have the effect of terrific bumps. A car whose suspension is designed and adjusted for a good road circuit is often uncontrollable here, owing to the inadequate axle movement usually allowed and the excessive stiffness of the springs. Though the comfort of the driver is a secondary consideration, one reservation must be made. The physical punishment inflicted on the driver of a racing car traveling fast on a bad surface is bad enough on some road circuits and tracks, but under extreme conditions it approaches the point where the jolting of the driver's spine begins to interfere with his efficiency. Adequate axle movement must therefore be allowed on very uneven surfaces, even if the stability of the car does not demand it, but it can only be safely allowed if the unsprung weight is sufficiently low.

Cars Discussed

By R. A. Railton, B.Sc.*

Independent Suspension

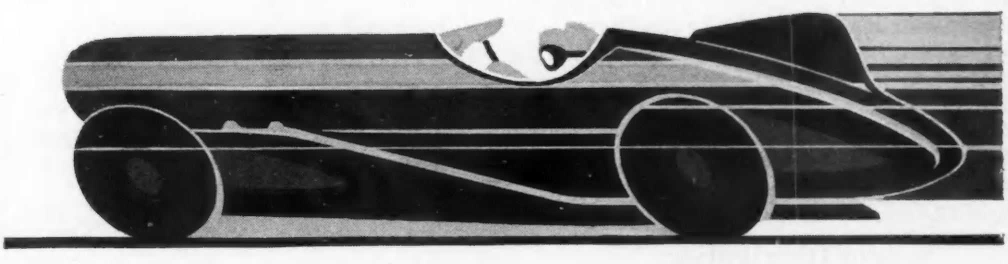
It is impossible to over-estimate the importance of unsprung weight. Independent suspension is adopted on nearly every modern racing car, but its chief advantages are not directly consequent upon its effect on the unsprung weight. In any type of axle the wheels, tires, and brake gear make up considerably more than half of the total weight of the unit, and for an independent system it is safe to say that the unsprung parts of whatever arrangement is used to support the wheels will increase this proportion still further. There is no doubt that it was first introduced (in Germany) in an attempt to reduce the unsprung weight to the lowest possible figure. It was soon found, however, that a car so equipped possessed certain advantages quite out of proportion to the mere saving of unsprung weight. It was found that such a car held the road on corners in a quite uncanny manner. It was also found possible to transmit more torque through the driving wheels without wheel slip. In a word, the adhesion was greatly improved, and it was also noticed that the worse the road surface the more pronounced was the difference. Further, it was found that these advantages were present whatever type, within reason, of independent suspension was used. In other words, what made the difference was the absence of a rigid member connecting the wheels. The nature of the mechanism employed to take its place was relatively unimportant. Why the absence of the solid connecting axle beam should make such a difference to the adhesion is a point upon which no two experts will agree. The basic principle is, probably, as follows. Consider a pair of wheels A and B running along the road (see Fig. 1 on next page). If A meets an obstruction and suffers temporarily impaired adhesion, B has to provide extra adhesion if there is to be no skid. With a solid axle, the movement of A over the obstruction is transmitted to B in such a way as to cause a sudden lateral shift of B's point of contact with the ground. This may well precipitate a skid if B's adhesion is already taxed to the utmost. With independent suspension of each wheel this reaction does not occur.

Chassis Frame

A factor which has a very far-reaching effect upon the behavior of the car on the road is the stiffness of the main frame. It is useless to attempt a nice adjustment of the suspension system if the chassis is sufficiently flexible to act itself as a spring, and an undamped one at that. The provision of the necessary strength usually ensures that the frame is sufficiently stiff, considered as a beam; but it is equally important that there should be a great resistance to torsional strains.

The frames of racing cars are often

* Paper read before the Institution of Mechanical Engineers, Great Britain. Abridged.



In this article the author analyzes the development of the racing car with the authority of a designer and manufacturer of world's record makers.

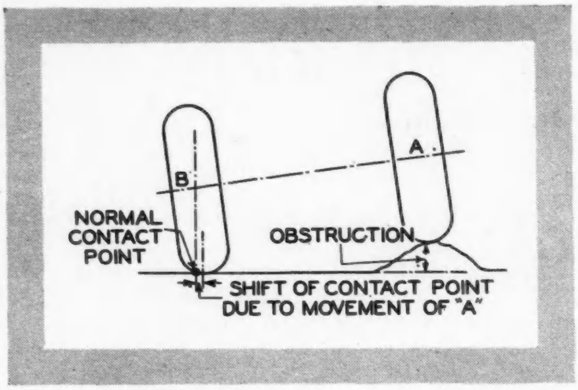


Fig. 1—Analyzing the action of skidding with rigid axle

constructed of two channel-section side members, connected by cross members, but unless the latter are of tubular section, the whole structure offers very little resistance to torsion, with the result that the desired action of the suspension may be completely upset. There has lately been a tendency to fill in the open side of the channel section, thus forming a box member and greatly increasing the torsional rigidity, but the resulting structure is inclined to be heavy. From a consideration of the stress distribution in a motor-car frame, there is no doubt that the ideal construction would be a single tubular trunk extending the whole length of the vehicle, and developments are taking place in this direction which may well become standard practice in the course of the next few years.

Tires

For long-distance, fast work the durability required calls for a large, heavy tire, working at a high pressure. This increases the suspension difficulty in two ways. The extra unsprung weight brings the usual troubles in its train, and the high pressure means that road shocks are transmitted without much diminution. On the other hand, a consideration which encourages the use of a tire of large section is its increased lateral stability. Any tire, when the car is rounding a corner, has a tendency to roll, or to "go over on its ankles," and under these conditions the path of the wheel is not at right-angles to its axis (see Fig. 2). This phenomenon is termed "creep" and, though not actually a skid, it has a bad effect on road-holding.

Weight Distribution

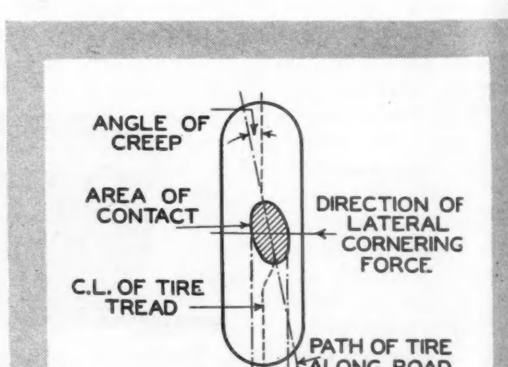
Few features of racing-car design receive less direct attention than the effect of the weight distribution upon the behavior of the car on the road. The guiding principle, until recently, seems to have been a determination to keep the car as short and as low as possible. As a general rule, this gives fairly good results, but it has limitations.

Two reasons exist for keeping the height of a racing car down. First, the lower it is, the less air it disturbs, and, other things being equal, the less wind resistance it offers. Second, the lower the center of gravity, the less likely is the car to turn over if it skids sideways into an obstacle. There was a general idea that the lower the center of gravity of a car, the less likely it would be to skid, or, the faster it would go round a corner without skidding. Naturally, then, the lower the car, the faster it would go around a corner without turning over. Today, even the ordinary sedan touring car is built so low that it will skid outwards long before the turn can be made sufficiently abrupt for it to capsize. There is now a fairly general agreement that if the center of gravity is too low, the tendency to skid is definitely increased. A car having a very low center of gravity behaves in a peculiar way when taken round a corner at near the critical speed. It will maintain a perfectly true course until that speed is exceeded, when it will slide right out in an uncontrollable skid.

Certain races are organized for cars in "touring trim," that is to say, they have to carry lamps, battery, spare wheels, etc. If the center of gravity is to be kept very low, the individual items must obviously also be as low as possible; that is to say, heavy units like the fuel tank and the batteries may have to be placed behind the rear axle, and heavy accessories in front of the radiator. The objection to this may not be apparent at once, but the car will almost certainly have the grave drawback of being slow to answer the steering, the large mass behind in conjunction with the mass of the engine forward having considerably increased the polar moment of inertia of the car, or its "flywheel effect," about a vertical axis.

With a car moving at a constant speed in a straight line, the angular velocity of the car about a vertical axis is zero, while round a curve of constant radius its angular velocity is constant. In neither case does its polar moment of inertia affect the situation. When, however, the car is turned from a straight course into a curved one, or when the radius of the curved path varies, its mass is subject to an angular acceleration. The amount of the couple producing this angular acceleration is limited by the friction of the tires on the road, and has a definite maximum for any given vehicle. If, therefore, the polar moment of inertia is high, the maximum angular acceleration will be low, and the car will take an appreciable time to follow the movements of the steering wheel. This effect can be very noticeable in extreme cases, and is particularly objectionable in a race over a twisting road. A very low center of gravity therefore is not neces-

Fig. 2—Illustrates the creep on a wheel rounding a corner



sarily desirable in a road racing car.

In the case of a track racing car, where the first consideration is the ultimate speed, one of the most important requirements is the reduction of the frontal projected area of the car in order to reduce its resistance to the air. This frequently does involve a very low center of gravity, which in this instance is not objectionable. In addition, the added safety from capsizing, in case of accident, is a real advantage. In the car specially built for hill climbs and short spring races the height of the center of gravity has a very important bearing on the performance. These events are really tests of acceleration, and the most important consideration is the reduction of weight of the vehicle, though there must be sufficient weight on the rear axle to supply the necessary adhesion for the tires. With a fairly high center of gravity and a very short wheelbase, quite an appreciable transference of weight from the front to the rear wheels occurs when accelerating, and the effect of an upward road-gradient still further increases this transference. This, in turn, increases the available adhesion, and permits a greater torque to be applied to the driving wheels without slipping. Incidentally, a car of these proportions is very suitable for negotiating the sharp bends usually included in hill climbs.

In considering the ideal proportion of track to wheel base for racing purposes, the requirements are again conflicting. Generally speaking, a long wheel base is steadier on the straight, and on curves at speeds below the critical or skidding speed, but it is fairly generally accepted that a short wheelbase will negotiate a sharp corner faster without skidding. The long wheelbase is more comfortable and therefore less tiring to the driver. This is an important point in a long race, but it has the advantages of extra weight, and, for a given construction, of greater flexibility of the frame. For these reasons, the use of a longer wheelbase than is actually required to find room for the driver, etc., is confined to cars intended for straightaway world-record attempts, and occasionally for long-distance work on banked or circular tracks. The actual wheelbase is usually kept as short as is consistent with the exigencies of space. There is remarkably little variation in width of track between designs otherwise very dissimilar. This dimension is connected with the question of the height of the center of gravity, and so forth. There seems to be remarkable unanimity in favor of making the wheelbase approximately twice the track width. This proportion has been arrived at as the result of a great amount of experience, and it probably represents as good a general compromise as is possible.

Front-Wheel Drive

Racing cars with a front-wheel drive have had a considerable vogue in America, where special conditions have favored the experiment. The majority of races there are held on saucer tracks, where a uniform high speed is maintained, and road racers of the European type are unknown. The advantages of front-wheel drive on a motor vehicle are chiefly of an indirect nature, and consist almost entirely in the better chassis layout obtainable by its use.

When first introduced, great claims were made on account of the fact that, on a corner, the propelling force in a front-driven car has a slight component radially inwards toward the instantaneous center, whereas with rear drive there is an outward component. This effect is illustrated diagrammatically in Fig. 3. It was therefore claimed that the front-driven car could be taken around a corner faster than the other. There is a certain amount of truth in this, but there is also one very serious drawback; for example, when a front-drive car is negotiating a corner at about the critical speed. In order to take advantage of this effect, the driver must have the throttle open, so that this centripetal tractive effort may be exerted. If he overdoes it a fraction and the car begins to skid, he can either follow his instinct and take his foot off the throttle, in which case the sudden reversal of this inward component of the tractive effort may cause the car to skid uncontrollably; or he can open the throttle still further, in the hope of further increasing the inward component so as to restore equilibrium. This action also increases the velocity of the car, so that his security is only temporary. It may be that the reverse effect in a rear-drive car is in practice a definite advantage, in that the driver gets a warning, in the shape of an incipient skid, which he can immediately check by taking his foot off the throttle.

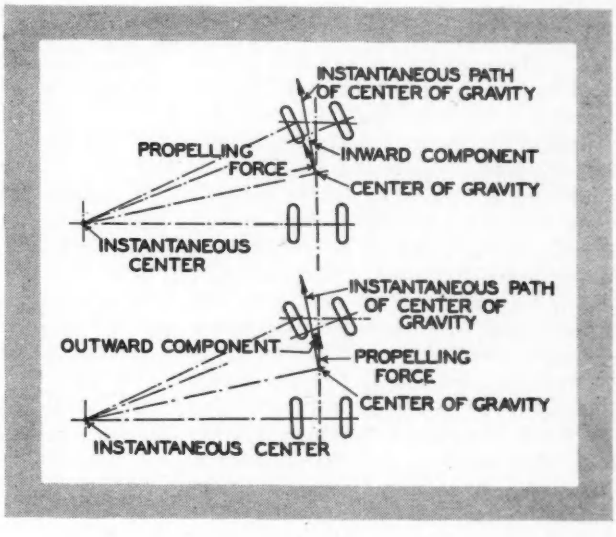


Fig. 3—Diagram of forces in cornering, with front-drive and rear-drive cars

Steering

The steering mechanism used on racing cars differs very little from that employed on the ordinary touring vehicle. The most important requirement is the maximum of rigidity in the linkage and other mechanism between the steering wheel and the road wheels. To be effective, this involves great lateral rigidity of the means of location of the front axle itself, and the whole of the front end of the frame. These are points which are frequently overlooked. Steering arms, frames, etc., adequate for touring purposes, may have slight deflections under load, producing a definite lag in the steering which is objectionable for racing purposes. This point is important chiefly because of its psychological effect on the driver. Road-race driving has developed into a fine art. The few first-class men available may handle many different makes of car in the course of a season, and the opportunity for real practice before the race often amounts to a total of less than an hour. If the handling of the car presents any peculiarities, or if the steering is anything but very good, the driver may only begin to settle down about half-way through the race. The best engine in the world will be of little use under these circumstances.

Brakes

The development of brakes in the last few years has been remarkable. Some years ago it was fashionable to use a servo-motor driven off the gearbox to apply the brakes, and to use a high pressure on comparatively small drums. This was quite effective, but largely lacked that delicacy of control upon which the driver's feeling of confidence is so dependent. Shortly afterwards, great improvements in materials led to the production of brake linings having a higher coefficient of friction and greater hardness. The use of these materials, in conjunction with increased drum diameters, made it possible to dispense with the servo-motor; and, except for the very largest cars, nearly every maker has reverted to the use of direct pedal operation.

For many years the brakes were operated by a system of rods and levers connecting the pedal with the ordinary double cam which expanded the shoe against the drum. With the advent of independent suspension, such a mechanical linkage became very complicated, and the recent perfection of the hydraulic system on touring cars has resulted in its sudden and almost universal adoption for racing. Special care has to be taken to insulate the working fluid from the hot drum, and special liquids of high boiling-point are used as an extra precaution. Fig. 4 shows the layout of a racing brake. It will be seen that surrounding the operating cylinder there is a shroud, insulating it from the hot drum and supplied with cool air through an external scoop. The provision of adequate braking for a car weighing nearly a ton and capable of 180 m.p.h. is no easy problem. "Adequate braking" in the driver's view calls for a deceleration of at least ½ *g* from top speed and about ¾ *g* from 100 m.p.h. down. Bearing in mind that, for a given deceleration, the rate of heat flow to the drum varies as the square of the speed, a moment's thought will show how much care has to be given to the design of the drums. Further, the drums are placed in the wheels just where the weight must be kept to a minimum. The solution up till now has been a thick and heavily ribbed light-alloy drum of large diameter, with a thin liner of hard steel shrunk inside it. Such a composite drum is shown in Fig. 5.

Transmission

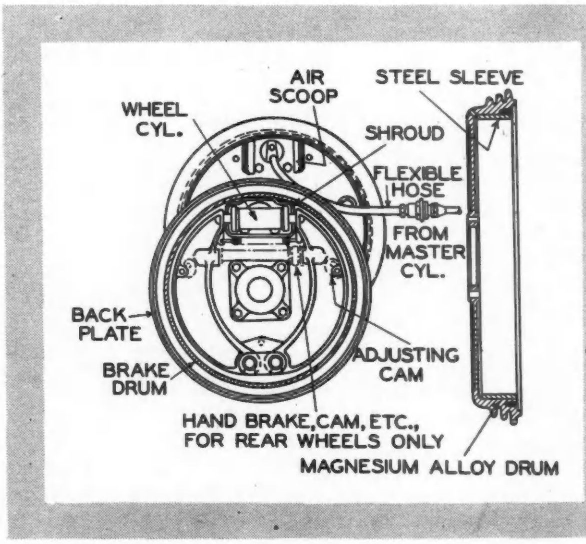
The transmission elements differ very little from the corresponding parts in the ordinary motor car. The familiar combination of clutch, sliding gearbox, and bevel-driven axle is today almost universal in both types of vehicle. The relative position of the units varies, but their working principle remains the same. There is a preference for a multiple disk clutch for racing, on account of its lighter weight. It is seldom used today on touring cars, owing to its tendency to "drag" when disengaged, and to the resulting difficulty of engaging the gear silently—an unimportant point in racing. The gearbox is generally of completely orthodox design, usually with four speeds and sometimes with only three. Several racing cars in this country have been fitted with planetary gearboxes of the Wilson type. These dispense with the clutch altogether and provide a nearly instantaneous change of gear, which is as nearly as possible foolproof.

Universal joints, where they occur, are usually of the Hooke type. The latest practice is to furnish the trunnion bearings with needle rollers packed with grease and sealed for life. The front-wheel drive car presents a special problem in universal joints. The front wheels must swivel about 25 deg. for steering, and, as they are also driven, they must accommodate a universal joint of small bulk and weight capable of transmitting the drive through this angle with uniform angular velocity. To meet this requirement, a very ingenious joint has been developed in America, where, in spite of the special machines required to make it and of the comparatively small demand, it is already in regular production. In view of the admirable way in which it fulfils its difficult function, it deserves to be better known in the field of general engineering. Fig. 6 gives sectional drawings of this joint. The final drive to the axle shafts remains what it has always been—the straight-tooth bevel. For racing purposes silence is unimportant, and the straight-tooth bevel has the advantage that it is easier and cheaper to produce in small quantities. Further, the axial thrust on the pinion is in the same direction on both drive and overrun, a consideration which simplifies and lightens the construction generally.

Engine

It is sometimes asked what possible use racing can be to a manufacturer, considering that his racing engine bears no resemblance to the one by which he earns his living. In actual fact, the lines of development of racing and touring engines are steadily converging. The knowledge gained in the evolution of the production engine has had its effect on the racing engine, and *vice versa*. The cast-iron cylinder and detachable head, developed for touring purposes, have been so perfected that they are now frequently used on racing engines. In the same way, the racing engine, after years of allegiance to ball or roller bearings for the crankshaft journals, has now reverted to the plain white-metal bearing. On the other hand, the touring engine is now almost invariably equipped with aluminum pistons, narrow piston rings, heat-resisting alloy valves, adequately stiff crankshafts, and high-pressure lubrication, all direct legacies from the racing engine.

The general arrangement of the racing engine is orthodox. It is usually of the multi-cylinder type, with one or two rows of six or eight cylinders in line. The cylinder head has usually a nearly spherical surface, with radially dis-



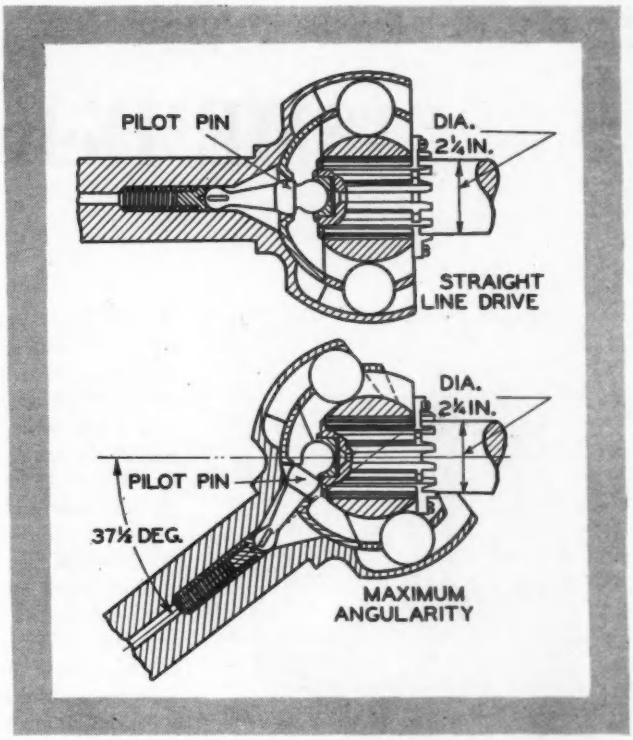
Figs. 4 and 5—Layout of a brake for racing cars, with special cooling means and (on right) section of a composite brake drum

posed valves. There are generally two camshafts, one for the inlet and one for the exhaust valves. The ignition plug is disposed vertically between the valves and is nearly always fired by a magneto. The working mixture is either aspirated naturally from one or more carburetors, or, as is now usual, pumped in by a rotary blower. For some time, the durability of the exhaust valve set a very definite limit to the flame temperature, and to the speed at which the valve could be operated. The solution of this problem has been the adoption of special steels, notably high-chromium, cobalt, and tungsten steels, the latter having properties similar to ordinary high-speed tool steel. This improvement resulted at once in greatly increased flame temperatures and compression ratios, as well as an increase in the rate of revolution.

The next limit to be reached was that imposed by the heat-resisting qualities and strength of the aluminum-alloy pistons. This problem was sometimes evaded by the use of a large number of cylinders of small bore, the superior cooling of the small pistons making the use of higher compression ratios possible. Here again, the use of special heat-resisting alloys, coupled with improved foundry methods, has provided the remedy. For the sizes in general use, the provision of reliable pistons does not present much difficulty today. This solution of the piston difficulty sent engine speeds up with a rush, and brought to an acute state the troubles already being experienced with bearings, particularly the big end of the connecting rod. Designers were beginning to give up plain bearings in despair, and were turning to roller bearings, in spite of the enormously increased cost. At the same time, plain bearings were being developed intensively for aircraft engines, where the weight of the roller bearing was prohibitive, so it was not long before the pendulum swung back, and the much improved plain bearing came into favor again. Today it is quite common to run plain big-end bearings at rubbing speeds of upwards of 3000 ft. per minute with unit pressures of 1000 lb. per square inch, and failure is comparatively rare.

As to bearing lubrication, the only point of unanimity is the method of introducing the oil, that is, under pressure from the hollow shaft. There is a wide divergence of practice in successful engines in the oilways provided on the bearings. Their presence or absence seems to make very little difference one way or the other. Another factor, which in some engines has set a limit to the performance, has been the persistent breakage of valve springs,

Fig. 6—A universal joint designed to meet the requirements of a front-wheel drive race car



but nowadays if sufficient care is taken in the original design, this trouble can always be avoided. At this stage, progress in design had arrived at a point where it was comparatively free from mechanical limitations. The engine could be relied upon to deal efficiently with all the fuel that could be got into it, provided the conditions (particularly the compression ratio) were suitable for that fuel. If the compression ratio was increased beyond that limit, either the mixture would pre-ignite or the character of the combustion would be found to change suddenly, and the charge said to detonate. It is in this field that most of the changes and improvements of the last few years have taken place.

Supercharging

It is obvious that a supercharged engine is likely to have a lower thermal efficiency, or a higher fuel consumption, than one developing the same power on atmospheric induction. If the original general race regulations had been based on car weight, or fuel consumption, instead of on the bore and stroke of the engine, designers would almost certainly have persevered with the development of the normally aspirated engine, an activity which would have been of infinitely more value to the manufacturer in his development of the touring car. In the last year or so the big Continental races have been thrown open to engines of any size. This, of course, has removed the main advantage of the supercharger, and has forced it to stand on its own merits; it must be said that it has stood the test very well. New cars built for these races have, without exception, been supercharged. This is no doubt partly due to the fact that designers have so far mastered the technique of forced induction, that they naturally hesitate to take the risk of experimenting in other directions. The main reason, however, is that, with present methods of engine construction, and for equal power outputs, a small engine plus supercharger weighs less than the larger unsupercharged one. So long as this remains true, engines designed to meet the present race regulations will probably continue to be supercharged.

Three types of blower are in general use. The Roots blower is used almost entirely on the Continent, while the centrifugal type is popular in America. Great efforts have been made in this country to perfect the rotating vane blower, and it has been used extensively. In America most races are run on special tracks, at a more or less uniform high speed, a condition which lends itself to the use of the centrifugal blower which obviously is only efficient at or near its designed speed. Given this condition, it can be made lighter than the other types, for a given output. It is usually of the single-stage type, having a high-tensile steel rotor about 7 in. in diameter, revolving at speeds up to between 30,000 r.p.m. and 40,000 r.p.m., the delivery pressure being from 8 lb. to 12 lb. per square inch. (*Turn to page 821, please*)

ASME Delves Into Cutting Tool

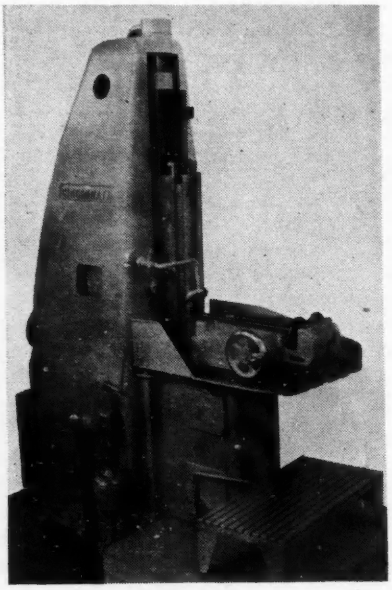


Fig. 1—A single ram, receding table broaching machine

THE semi-annual meeting of the American Society of Mechanical Engineers held in Detroit, May 17-21, featured a variety of subjects of interest to the various divisions of the society and included a number of papers and sessions of specific value to automotive engineers and production executives.

A summary of the present development of the art of surface broaching was presented by S. Einstein and M. Romaine of the Cincinnati Milling Machine Co., in a paper entitled, "Surface Broaching in the High-Production Industries." According to the authors the automotive industry offers the greatest possibilities for surface broaching. Among parts capable of being so machined are top, bottom, manifold face, water jacket, and flywheel housing of cylinder blocks; cylinder heads; crankshaft bearings; connecting rods and caps; shock-absorber arms; steering knuckles; shock-absorber bodies; transmission shifter rods; rear-axle shaft ends and many others.

It is pointed out in the paper that the limiting factors of surface broaching are (1) Work must be strong enough to withstand broaching stresses set up. (2) Work must have the ability to be supported firmly. (3) Work cannot have any obstruction in plane of surface to be broached.

A single-ram, receding-table, vertical broaching machine for broaching rear-axle shaft ends is illustrated in Fig. 1. On this machine a special work-holding fixture, mounted on the receding table is arranged to hold two shafts in V-blocks, one located directly under the cut and one at the opposite end. The end location is taken against the inside of the wheel flange. Both shafts are clamped simultaneously by a hand-operated clamp in contact with the outside of the wheel flange.

The operating cycle is to load two shafts, advance the table, broach two pieces, and return the table and the ram to the starting position. The operator removes the two pieces and loads the table with two more while the ram is returning, only a little extra time being required to complete the loading of the work at the end of each cycle.

Broach speed is 31 f.p.m. forward and 47 f.p.m. on the return stroke. The material is a steel forging; ¼ in. of metal is removed from each piece; and the production is 356 pieces in 52 min. The broach tools are high-speed steel.

An extremely interesting operation where large production is obtained on pistons for a hydraulic shock-absorber is illustrated in Fig. 2. These pistons are castings that have webs cast across the end of the cored-out slot to permit the part to be ground on a centerless grinding machine. The broaching operation opens the slot by removing the web and must produce a slot of rather close tolerance and good finish.

Production requirements are rather high and a somewhat novel arrangement was used to obtain it. Instead of the oscillating or index type of table normally used on the duplex broaching machines, this machine is equipped with a table that indexes back and forth across the face of the machine.

In the center of the fixture is an indexing drum having 10 stations located axially on the drum. On each of the stations, four pieces are located by pins through the cored hole in the piston, and the operator's duties are limited to putting pieces on these pins. The drum is located on a slide that moves back and forth at right angles to the face of the machine so that the pieces, which are set on the drum with their axes horizontal and have been indexed into that position, are pushed forward

Fig. 2—Broaching pistons for a hydraulic shock-absorber

Design, Broaching and Welding

into holes in the work-carrying shuttles. This ejects the finished pieces between the column and the knee of the machine and collects them in the base.

After the four pieces have been inserted into the shuttle, the drum is retracted. At the completion of the strokes of the two rams, one up and one down, the work shuttle moves sidewise, bringing the fresh pieces that have just been loaded up in front of one ram and also bringing those that are finish-broached in front of the drum. The drum then moves forward, indexing on its way, pushes the four broached pieces out of the shuttle, and replaces them with four new ones. This action is continuous, and the drum is automatically indexed and timed with the motion of the work-holding slide. A production of 2160 pieces in 52 min. is obtained with a broaching speed of 41 f.p.m.

Fig. 3 shows a special horizontal machine that has been developed for broaching the joint face, bolt bosses, and water outlet on heads for a six-cylinder automobile engine. A special 90-deg. indexing fixture is arranged with two work-holding fixtures, 180 deg. apart, each arranged to hold two cylinder heads. This feature permits work to be loaded, removed, and interchanged while the ram is making its forward and return strokes.

Operations are progressive, the top bosses and the water-outlet face being machined first by locating from the combustion chambers on the opposite side, while the cylinder-block joint face is machined last by locating from the finished top bosses. When the ram completes a broaching stroke, the fixture is automatically indexed 90 deg. bringing one finished and one semi-finished cylinder head to the top station and one fresh and one semi-finished, but freshly loaded, cylinder head to the station below the trunnion. As soon as the indexing movement is complete, the operator throws the directional-control lever to return the ram and, while it is returning, he releases hydraulically operated fixture clamps on the two pieces at the top. He then pushes the finished head down the chute and the semi-finished head into a trunnion transfer cradle. Immediately upon the completion of the ram's return stroke, the fixture is indexed 90 deg. and the directional-control lever is thrown to start the ram on its broaching stroke. The two work-holding stations are now facing the operator in the loading position. The semi-finished cylinder head is pushed in position for second operation and a fresh cylinder head is taken from the conveyor and placed in position for first operation.

Material broached is cast iron. The tool is of the inserted-blade type with 42 blades for roughing and semi-finishing and one tungsten-carbide blade for finishing. Ram speeds are 31 f.p.m. on the cutting stroke and 63 f.p.m. on the return. From 3/32 to ⅛ in. of metal is removed and the production is 77 pieces in 52 min. Automatic chip-disposal facilities are provided.

Since surface broaching is a relatively new art, design of the tools is based on the experience gathered from previous installations and experiments on practical applications. Two major items, size and shape, control this design. Naturally, the former is determined by dimensions of the piece to be broached, number of teeth, their pitch, percentage of teeth for roughing and finishing, rake and clearance angles, and whether the teeth are straight, spiral, or staggered. The latter is definitely governed, to a greater or lesser degree, by the part to be broached.

Low unit-time of surface broaching is due, in part, to the speed at which the cutter passes over the work, which is from 12 to 25 times faster than the rate in milling. Feed rates in milling steel forgings are seldom in excess of 8 or 10 in. and, in most milling operations on these materials, a lower rate is used. On the other hand, the normal speed for surface broaching a forging is approximately 30 f.p.m. In either milling or broaching, distance traveled is equal to length of cut plus distance across the cutter, and the latter is considerably greater for a broach than for a milling cutter. Higher speeds more than compensate for the difference, with the result that the cutting time by broaching is usually much faster than for milling.

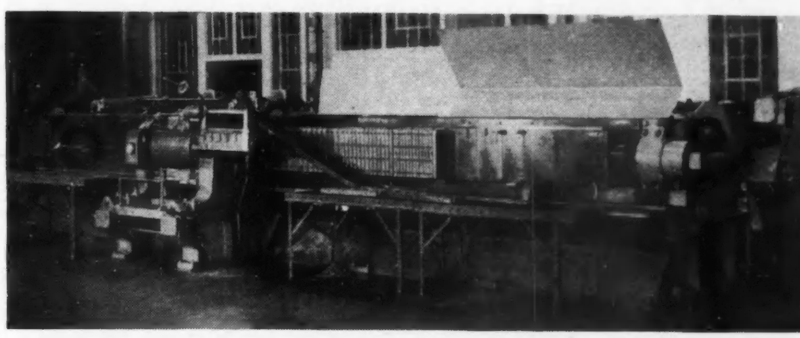


Fig. 3—Horizontal machine for broaching the joint face, bolt bosses, and water outlet on heads of a six cylinder automobile engine

At a session sponsored jointly by the American Welding Society and the machine shop practice division of the ASME, papers on the welding art were presented by Everett Chapman, president, Lukenweld, Inc., and C. L. Eksergian, chief engineer, Budd Wheel Co.

Mr. Chapman, whose photoelastic studies of highly stressed structures are classic, discussed the problems of welding elements subjected to high stress and fatigue. In his opinion, welding must not be used as a universal method of construction since it has certain definite limitations which must be appreciated by the designer. Three basic principles should be considered when studying a welding application—

(1) material, (2) design of structure and welded joints, (3) control of thermal stresses.

For the material, the author urges the use of low-carbon steel containing no more than 0.18 carbon; also the use of a good grade of material free from porosity and excessive impurities. Unless the structure is properly designed for welding and unless the proper technique is utilized to assure perfect welds, there will be small areas of incipient cracks which will ultimately cause fatigue failure.

With proper techniques and knowledge of the problems, it is possible to build very successful welded structures for highly-stressed machine elements with an appreciable reduction in weight and at lower cost as compared with good castings for the same service.

C. L. Eksergian described the experience of his company with a novel hydromatic welder for producing chassis frames of closed box-girder construction. The first two machines placed into service were very much of an experiment and the results will determine whether or not the process will be continued, although the author is convinced that the hydromatic machine is the best answer in the present state of the welding art.

The machines described were built by Taylor-Winfield in cooperation with Budd experts and cost about $100,000 for the initial installation. Improvements have been made during the course of production and further changes are contemplated in the solution of several practical problems.

Each machine has 240 pairs of upper and lower electrodes with eight welding transformers, each serving 30 pairs of electrodes. The machine can produce 500 frames in eight hours.

One of the important contributions to the design of the equipment was the use of "floating" upper and lower electrodes, instead of the usual platen, so as to eliminate some of the pressure variations which develop when the machine attempts to press the two sheets against a formed platen. With floating electrodes, the only variation in pressure is due to the load required to press the sheets against one another.

In the course of the discussion, Mr. Eksergian compared the economic advantages and disadvantages of various types of welding machines, in an effort to define the place of each type of resistance welding method.

The cutting metals research session at the ASME meeting comprised three papers and was enlivened by discussion from the floor.

Hans Ernst and Max Kronenberg of Cincinnati Milling Machine Co., presented a very timely study entitled, "Grinding of Cemented-Carbide Milling Cutters," based upon current practice in the U. S. and Europe. According to the authors, a number of trends are quite evident. The most important of these is the adoption of the new diamond wheels both for roughing and finishing with wet grinding to a moderate degree. Another positive trend is toward the use of a single cutting edge rather than the double edge which has been extensively used.

Table 1
Recommended Angles for Grinding Milling Cutters

Angles (see Fig. 4)	A	B	C	D	E	F
Cast iron	4	8	5	3	6	3
Aluminum	8	12	30	4	8	30

A comparison of the two types of tool forms together with the recommended angles is found in Fig. 1 and Table 1.

The authors recommend the use of a cup wheel rather than disc wheel for grinding but are inclined to modify this by the statement that the type of wheel is largely determined by the design of the grinder.

Discussion indicated some differences in recommended practice. For example both Ingersoll Milling Machine and Carboloy prefer the use of a disc wheel, although the latter sees the desirability of using the cup wheel for milling cutter tips. Carboloy recommends a wheel speed of 5280 fpm with automatic controls for all functions of the grinding machine. This organization also feels that cutter accuracy within 0.001 in. is sufficient for all practical purposes.

Prof. Charles J. Starr of the University of Illinois presented a paper entitled, "A Study of Lip Clearance on Twist Drills," whose purpose largely was to determine the results obtained with the use of commercial drill pointing machines, five different makes being used.

By a special technique, the contour of the warped surface on the drill point was measured and charted, indicating that in most cases too much clearance is ground near the circumference of the drill. One of the demonstrations indicated that hand-pointing gave results approximating more nearly ideal conditions. The study developed the point that the rounding or breaking of the sharp corners gave increased drill life for steel also that modifications in drill point angle gave better results. According to this investigation, a 70 deg. point seems best for cast iron while a point angle of 130 deg. gave best life for steel.

Discussion brought out a number of controversial points but the best summary came from Mr. Hinton of Wm. Sellers & Co., who emphasized the fact that the theoretical drill point proportions are meaningless since practice has caused many important variations. He suggested that the best approach would be to find the proportions that give best results in the shop and then let the drill grinder manufacturers modify their machines so as to produce the practical results.

R. C. Deale of the E. W. Bliss Co., presented a resume of studies and experiments carried on under the auspices of the ASME special research committee on the cutting of metals. This committee has been working for a number of years on the development of metal cutting practice which is to be correlated and published in handbook form for use by industry. Much work remains to be done but the results will form the first comprehensive handbook presentation in this important field.

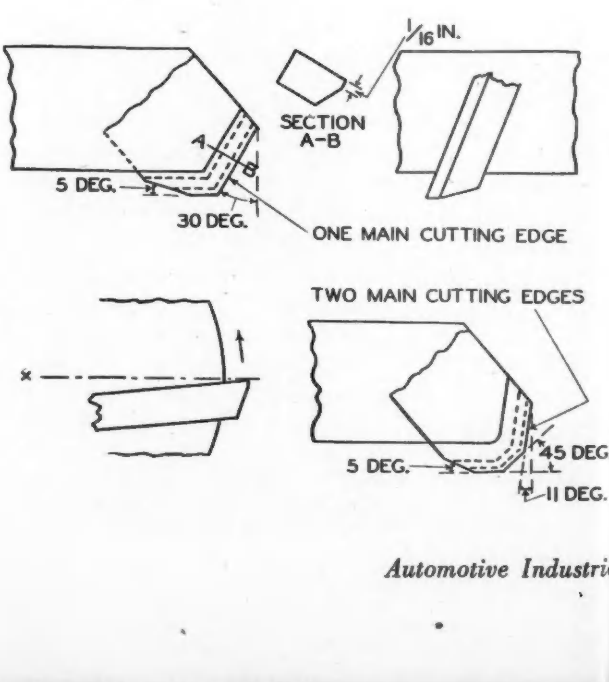
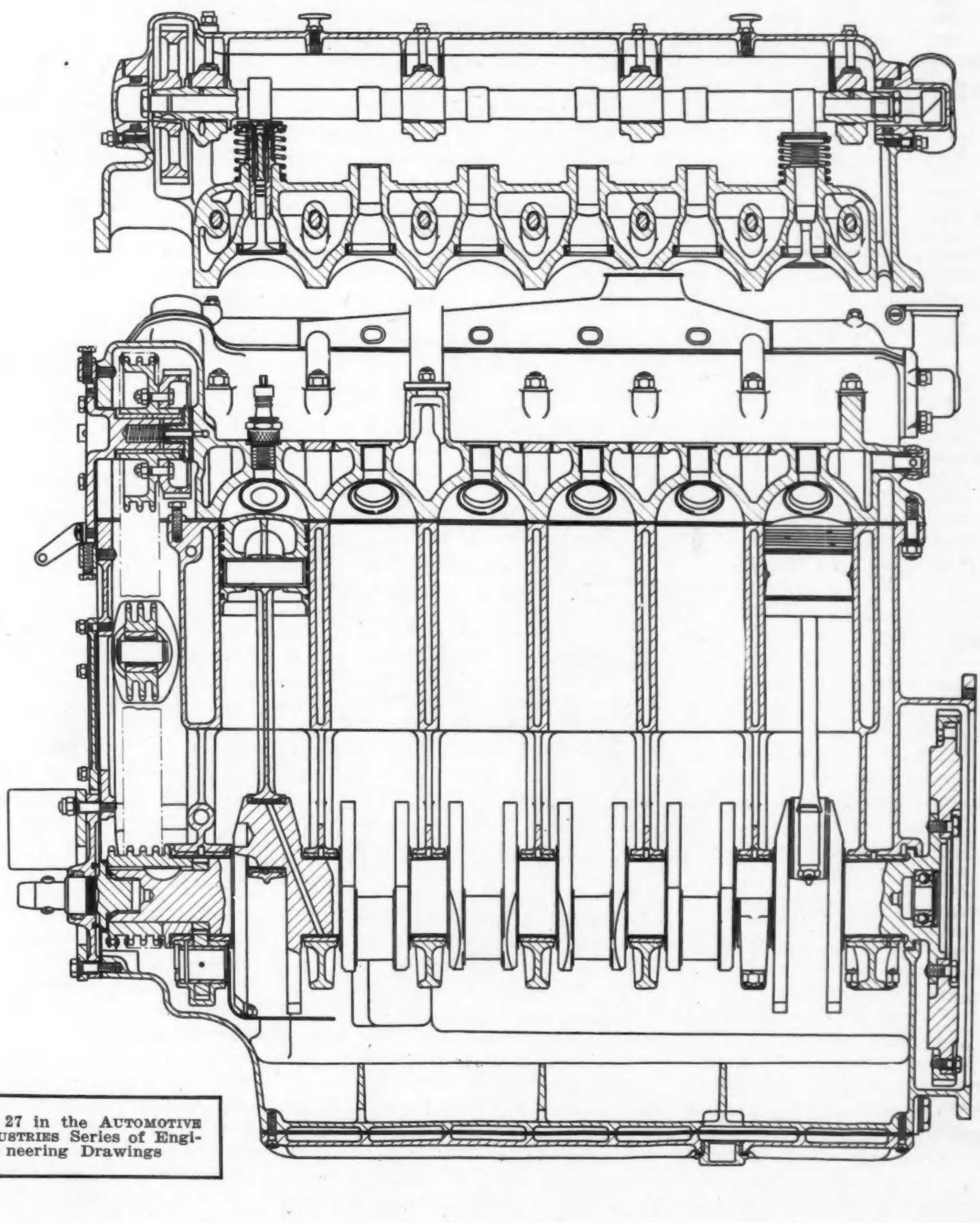


Fig. 4—Various angles to which cemented-carbide milling-cutters are ground

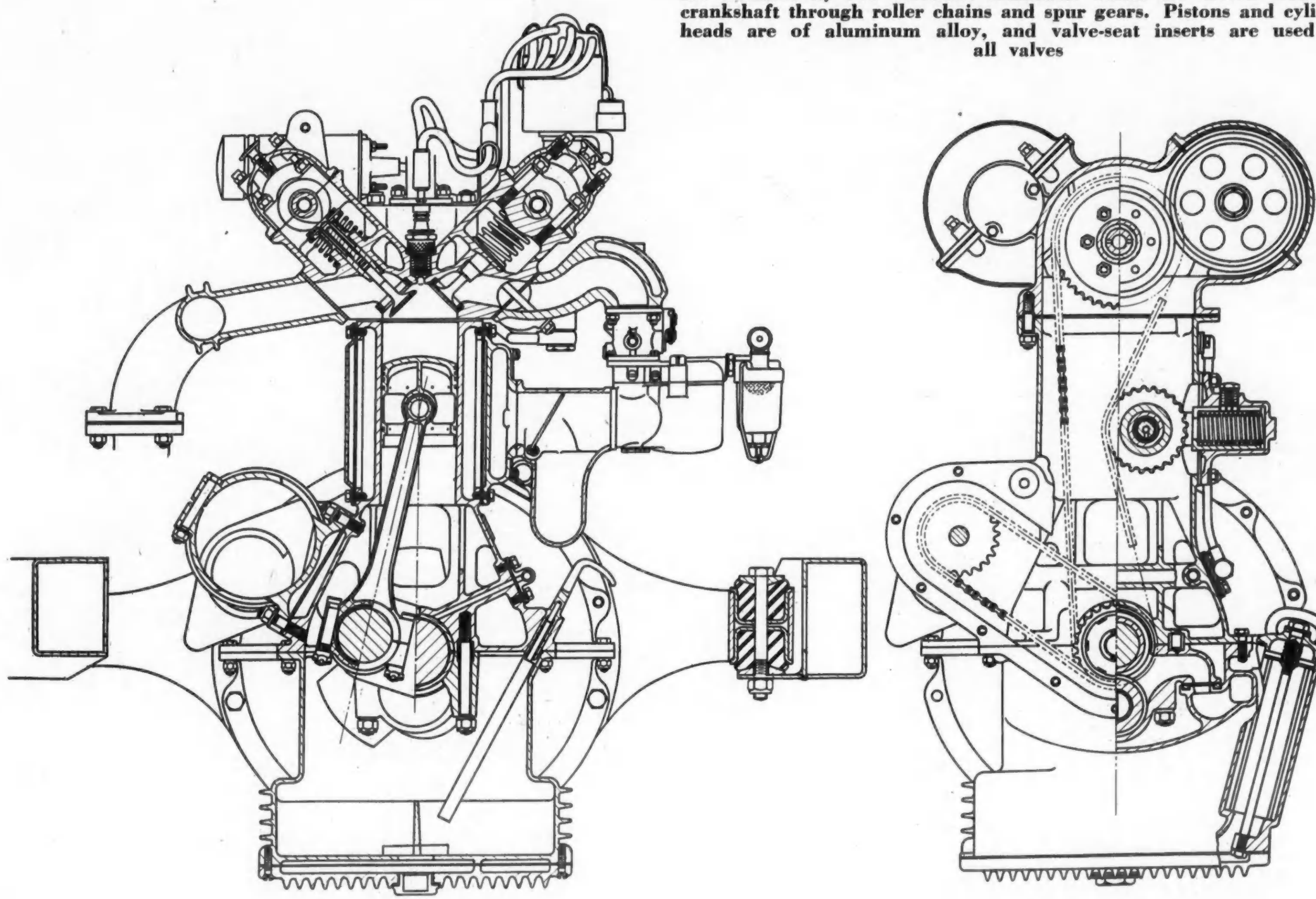
Alfa Romeo Six-Cylinder Engine Model 2300 B

This is an engine of 70 mm. bore and 100 mm. stroke (2.76 by 3.94 in.). The piston displacement is 141 cu. in. and the rating 74 hp. at 4000 r.p.m. The engine is actually being built in three different types, with different compression ratios, the output ratings ranging from 70 to 95. The 95-hp. engine (Pescara type) is fitted with two Solex carburetors, while the other types have a single carburetor



No. 27 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings

Alfa Romeo Six-Cylinder Engine Model 2300 B



Valves are inclined in the cylinder head at an angle of 45 deg. and are actuated by two overhead camshafts which are driven from the crankshaft through roller chains and spur gears. Pistons and cylinder heads are of aluminum alloy, and valve-seat inserts are used for all valves

Design of Racing Cars Discussed

(*Continued from page 815*)

By far the most largely used type is the Roots. The blowers are now run at speeds up to 10,000 r.p.m., delivering air at up to 25 lb. per square inch. It is difficult to obtain any reliable figures as to the efficiency under these conditions, but the satisfactory results obtained from the power unit as a whole seems to indicate a figure of the order of 60 per cent. The rotors are usually of steel, either two- or three-toothed, and the casings of aluminum alloy, heavily ribbed for both stiffness and cooling. The clearances, of course, have to be considerable, and this seriously affects their performance at low speeds, though this is not a matter of grave importance for racing.

The third type, the rotating-vane machine with a drum revolving in an eccentric casing, and carrying sliding radial vanes, which follow the contour of the casing, has presented many difficult problems, chiefly in connection with the high rubbing speeds involved, and with the durability of the surfaces concerned. Superchargers of this type have, however, been produced which appear to show rather better efficiencies than the Roots type, particularly at low speeds. They are, in their present form at any rate, very sensitive to lubrication, and it is difficult to supply adequate lubrication to the blower without blowing an excessive amount of oil through the inlet pipe and into the engine. Up until the present it has not been found possible to run superchargers of this type reliably and efficiently at speeds of about 5000 r.p.m., and they are thus heavier and more bulky than a Roots blower for the same duty.

Modern multi-cylinder engines are called upon to function efficiently over a wide range of speeds, and the size of the gas passages has to be made sufficiently large to provide the least possible pipe loss at the highest speed in the range. This means that the gas velocity at the lower speeds has to be kept very low. The working mixture, on leaving the carburetor, contains very little fuel vapor, but is chiefly a moving column of air containing droplets of fuel. One of the biggest problems is to prevent these droplets from depositing on the walls of the pipe, and to distribute them evenly between the cylinders. Thus, when the inlet pipe branches off to the various inlet ports, the inertia of these comparatively heavy particles of fuel may cause them to overshoot certain branches, thus starving certain cylinders and choking others. But when this raw and imperfect mixture is led straight from the carburetor to a rapidly rotating blower, the violent mechanical agitation, coupled with the rise in temperature due to the sudden compression, certainly tends to make the charge more nearly homogeneous, and probably actually vaporizes a considerable portion of the fuel. In this condition, the charge behaves more nearly as a true gas, and even distribution among the cylinders is less difficult. It is sometimes found that, even with a blower so small that the delivery pressure is scarcely above atmospheric, the performance of the engine at low speeds, and consequently the acceleration of the car, are greatly improved, simply due to the pulverizing action of the blower on the fuel. It may be noted here that attempts at intercooling have been made from time to time without, however, meeting with very marked success.

Fuels

One of the factors setting a limit to the output of an engine is the tendency of the charge to detonate when the compression ratio is increased beyond a certain point, varying with the size of the cylinder and the design of the combustion chamber. Another limiting factor is the tendency to actual pre-ignition as the compression ratio is raised.

Certain grades of gasoline, and also benzol, have a marked effect in delaying detonation. Of these, only benzol was commercially obtainable, and for a long time, therefore, racing engines were usually run on a fuel containing a proportion of benzol sufficient to eliminate detonation. The compression ratio was nevertheless always limited by the tendency to pre-ignition.

The next step was the discovery of the effect of fuels having alcohol as their base. If the flame temperature can be kept down, the compression ratio can be correspondingly increased, and hence the power, although, of course, not in the same proportion. Although alcohol has a poor calorific value, it has two advantages in this connection. It has a high latent heat of evaporation, and it is peculiar in that its vapor will burn when mixed with a good deal less air than is needed for complete combustion. If, therefore, an engine is run on a very rich mixture of alcohol and air, so much heat is absorbed in the vaporization of the excess alcohol and in further heating the vapor, that the flame temperature is considerably reduced. If the compression ratio is then raised until the flame temperature under these conditions is just under the pre-ignition limit, then considerably increased power output can be obtained. For various reasons, among them the inability to start cold and to run throttled, pure alcohol is not a suitable fuel for a racing engine. In practice, it is usually blended with suitable proportions of ether, benzol, and other constituents, according to the requirements of the particular engine. There is now available another agent, a derivative of lead, which enables the detonation point to be delayed, and which acts by controlling the rate of combustion rather than its ultimate temperature. The admixture of even very small quantities to ordinary gasoline has a very marked effect in delaying the detonation point. This addition is often used in combination with alcohol mixtures in ultra high-compression engines.

Finally, in the last eighteen months, great strides have been made in the commercial production of what are called "100-octane" fuels, having a very high resistance to detonation. The properties of such fuels have been known for some time, but it has only recently been found possible to synthesize them on a commercial scale. Such fuels include blends of iso-octane or isopropylether with aviation gasoline, and a small addition of tetraethyl lead. They have been intensively developed for the aircraft industry in America, chiefly for the sake of the reduced consumption and the resulting saving in fuel weight. There is little doubt that their use in a suitably designed racing engine will, before long, be the means once again of stepping up the standard of performance.

World Record Cars

The unusual-looking cars which are built from time to time to attack the various world speed records are far too ponderous and unhandy to compete with a road-racing car on its own ground. The construction and running of these cars is nearly always a private venture. Of the total cost of producing any new car, at least three-quarters is absorbed by the manufacture and development of the engine. Naturally, therefore, anyone contemplating the construction of such a car will save a

lot of money if he can buy the engine ready-made. In this country we are fortunate in having a range of first-class water-cooled aircraft engines which are reasonably well suited by their general layout for installation in a motor-car. They can be obtained in various shapes and sizes from 500-hp. to 2500-hp. units, the smaller sizes being suitable for the long-distance records (from 1 hour to 24 hours) and the large for the flying mile, or the so-called "land speed record." Full advantage has been taken of this source of supply (unique to this country), with the result that Great Britain has, for some years, figured prominently in the record book. For this application the chief disadvantage of the aircraft-engine is that, owing to the necessarily low optimum propeller speed and the high degree of reliability required, it usually has a comparatively low crankshaft speed. In a motor car this means (1) that the motor is rather bulky, increasing the size and weight of the car, and (2) that the transmission must also run at a slow speed and is therefore heavy. Weight shortens the life of the tires, and of the track upon which the car runs. The latter statement may sound absurd, but it is a fact that the chief limiting factor in long-distance record-breaking today is the ability of the track surface to withstand the destructive effect to which it is subjected.

Long-Distance Record

The world's one-hour record now stands at 170 m.p.h., and the 24-hour record at 153 m. p.h. In the last two years these records have changed hands frequently between the three rivals (two British and one American) who are at present competing in that field. All three use cars having aircraft-engines of about 25-litres capacity. Two of the three are cars of normal construction. The other has front-wheel drive, which for this type of work appears to have certain advantages. All three are probably capable of raising the 24-hour record by another 20 m.p.h. if a better track could be found. It is sometimes asked why the Germans and Italians with their 180-m.p.h. road-racing cars do not go out in their spare time and capture the long-distance records. There is no doubt that they have the speed, and their light weight would make them easy on the track and on tires. On the other hand, their motors are not designed for prolonged full-throttle running (which is never required in a road race) and it is doubtful whether they would stand the strain of a 24-hour record attempt.

The "Land Speed Record"

Still further removed from the true racing car are those vehicles which, for many years now, have held the world's land speed record. Hitherto, considerations of cost have meant the use of an existing aircraft-engine, and the resulting vehicle has been comparatively bulky and heavy by reason of its slow-speed engine. Criticism is sometimes levelled at cars like Sir Malcolm Campbell's Blue Bird in that they are only (*sic*) a hundred miles an hour or so faster than other cars with a quarter their power and bulk. It is obvious that the use of high-speed engines of the same power specially designed to fit, would result in a considerably smaller, lighter, and, therefore, faster car. At the same time, it should not be forgotten that, other things being equal, the larger the car the faster it will be.

The tire equipment of these cars is interesting. The tires used nowadays for this purpose are about 38 in. in diameter, and revolve at a maximum speed of about 2700 r.p.m. They have each to support a load of up to one ton, with momentary shock loads of two or three times that figure. The weight on the wheel causes a deformation of the tire casing at the point of contact with the ground, and, as the wheel revolves, this deformation travels around the tread. This continuous deformation of the casing represents a definite amount of work done, and converted into heat, not at the surface, but more or less uniformly throughout the fabric between the inner tube and the tread. As may be imagined, at speeds over 2000 r.p.m., the amount of this work is very considerable, and, owing to the low heat conductivity of the material, the temperature of the fabric rises very rapidly and may soon reach a point at which the strength of the rubber is affected.

The strength of the tire as a whole is controlled by the cord structure, which is unaffected by these temperatures, but the rubber tread, outside the cord structure, is held in position solely by its own adhesion, and if the strength of its inner surface deteriorates through heat, the whole tread will probably fly off under the very heavy centrifugal loading. For these very high-speed tires, this trouble has been eliminated by the evolution of a grade of rubber showing a remarkable strength at high temperatures, and by the expedient of reducing the thickness of the tread to an absolute minimum, consistent with the necessary durability. Actually, the tread is less than 1 mm. thick. In spite of this, the quality of the rubber is such that, after use, the treads are often absolutely unmarked. Further, in order to reduce the deflection to a minimum, the tires are run at very high pressures, usually about 120 lb. per sq. in. From having been at one time the most serious limiting factor in the design of racing cars, the tires are now about the last item to cause anxiety.

The chief problem with these ultra high-speed cars is how to reduce the aerodynamic drag to a minimum. A motor-car must have at least four wheels on the ground, and it is obviously difficult to do anything about the violent air disturbances which certainly exist in the region of these four zones of contact. Further, the close proximity of the ground to the underside of the car undoubtedly has an adverse effect of whose amount little is known, due chiefly to the difficulty of imitating the conditions exactly in a wind tunnel. Wind tunnel tests are, nevertheless, always made when developing these bodies, and, as between models of the same general type, they furnish quite a useful basis of comparison. Some idea of the magnitude of the wind resistance can be inferred from the fact that, at 300 m.p.h, even with a carefully streamlined car, the resistance approaches the limit of adhesion between the rear driving wheels and the ground. The air resistance is about equal to the resolved gravitational pull on a gradient of 1 in 5. The fact that a 5-ton car like the Blue Bird could (*in vacuo*) climb a 1 in 5 gradient at 300 m.p.h, furnishes a graphic illustration of what a 2,000-h.p. motor-car really means. Furthermore, it is easily seen that under such conditions any slight imperfections of the road would quickly induce wheel spin. The obvious solution is to drive all four wheels, instead of the rear two only, as has been done hitherto. There are considerable mechanical difficulties in the way of effecting a four-wheel drive with engines of existing design, but there is no doubt that it will be essential on these cars before long.

It is no use producing a car capable of beating the record if it cannot be accelerated up to, and slowed down from, its top speed, inside the total length of straight track available. Probably the best of the known tracks is the natural salt bed in Utah, U.S.A., where Sir Malcolm Campbell established the present record in 1935. Here there is a 13-mile straight run, absolutely level and having a surface particularly kind to tires. The "measured mile" is, of course, in the middle, which allows 6 miles for accelerating and another 6 miles for slowing down. This is ample for speeds up to 300 m.p.h, but would be distinctly on the low side for speeds in the region of 350 m.p.h., which will shortly be the objective. Such a car would have to reach 300 m.p.h in about 3 miles, as it would need just about another 3 miles, or 6 miles in all, to reach 350 m.p.h at the point where it entered the measured mile. The brak-

ing arrangements would also need serious consideration. While it would not be difficult to provide the necessary braking effort, the weight of whatever mechanism were employed would, of course, affect the acceleration adversely.

Speeds in the region of 230 m.p.h. have recently been accomplished on a new motor road in Germany which is dead straight for 30 miles or 40 miles. Provided it were sufficiently level, the use of such a road would simplify enormously the design of a 350-m.p.h. car. The author, however, fears that even if the road were sufficiently level to start with, the inevitable settling of its foundations would, in a short time, make it unsafe for such speeds.

So far as the immediate future of racing cars is concerned, there is considerable activity at the moment. Two or three cars are being prepared for attempts on the land speed record, and it is not unlikely that we may hear of a speed of 6 miles a minute.

Cast Iron Gets Talked About

(*Continued from page 805*)

treatment is to allow the part to take its definite set to avoid and minimize distortion which might occur in subsequent nitriding. After this treatment the parts should be examined and if appreciable deformation has occurred the parts should be rectified at this stage and re-established.

(3) Finish machine and grind surfaces required to be hardened. If surfaces not required to be hardened are to be protected by tinning, this operation may be done prior to finish-machining in order that any tin adhering to the surfaces required to be hardened can be removed in the finish-machining operations. If protection is carried out by painting then this can be done after finish-machining and grinding.

(4) The nitriding process leaves no scale but merely a dull matt film which can be removing by buffing or lapping or rubbing with fine emery.

Olds Automatic Transmission

(*Continued from page 809*)

8 m.p.h. Of course, the acceleration is not quite as good in this case as when starting with the lever in the low forward position, but this method of starting is generally quite satisfactory in traffic and results in an automatic shift to fourth at about 23 m.p.h.

A perspective view of the entire system is shown in Fig. 6. The control unit has three chief elements—a rear-unit or manually-controlled valve which is positioned by the hand lever; a front-unit or automatically-controlled valve, controlled by the governor for operating the front planetary unit; and a third valve controlled by the throttle, which affects the operation of both front and rear units.

In addition to the control-valve mechanism, the hydraulic system comprises means for the regulation of the oil pressure, including pressure regulators, safety stops, blow-offs, and other elements.

When this automatic transmission is installed in the Oldsmobile Eight, the car is provided with a rear axle having a gear ratio of 3.55:1. With the standard transmission a rear-axle ratio of 4.37 is used, and the automatic transmission, in addition to its other features, therefore offers the advantages usually associated with an overdrive, that is, reduced engine speed for any given car speed, a smaller number of crankshaft revolutions per mile, and greater fuel mileage.

Automatic Drill Designed for IHC Line

PRECISION is an outstanding characteristic of the manufacturing methods and production equipment developed for building the TracTracTor at the International Harvester Co., tractor works in Chicago, Ill. This plant, said to be the world's largest tractor works, is proud of the modernity of the equipment and methods installed to produce its new tractor line.

As an example of the equipment used here, we show a photograph of a massive Baker Bros. drilling machine which is used for automatically drilling various holes in the right and left crawler links. This machine, known as the model 60 of the Baker Cleanline series, was designed specifically for the IHC plant. It is hydraulically operated, with a 5-station fixture cycle, and features 30-in. ways, a long saddle, and a massive drilling head.

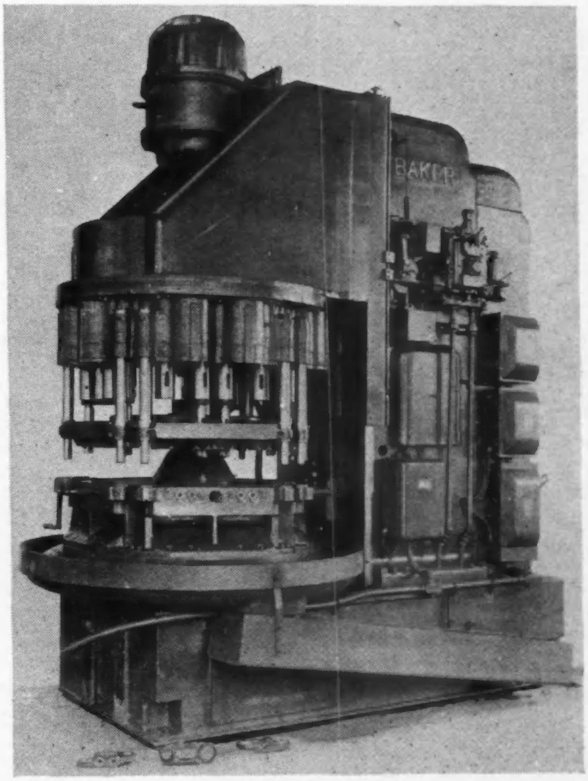
The operating cycle comprises a combination of synchronized movements including—a double feed and delayed reverse, a coarse boring feed with automatic change to fine feed for facing, a positive stop allowing several revolutions before tripping so as to assure a square-faced surface, and a simplified oil gear pump rapid traverse feed. The operator chucks and unloads while the tools are cutting so that there is no interruption in the machine cycle.

The job done by this machine comprises the core-drilling and a reaming of two holes while a large hole is rough- and finish-counterbored. Each cycle finishes one right and one left tractor link.

A horizontal unit with a four spindle head is also incorporated in the machine for drilling two holes simultaneously in two pieces.

French Manufacturers Complain

French manufacturers of injection pumps are complaining of inadequate protection against foreign competition. They hold that an injection pump weighing between 10 and 20 lb. and the value of which ranges between $50 and $100, or amounts to even more, is subject to the same rate of duty as an ordinary cast iron water pump costing between 6 and 8 cents per pound. This rate is not quite 3 cents per pound.



Baker Bros. hydraulically operated, automatic drilling machine designed specifically for the I.H.C. production line

BUYERS' GUIDE

Automotive Products and Factory Equipment Manufactured by Advertisers in This Issue

See Alphabetical List of Advertisers on page 44

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(Turn to page 42, please)